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WORD RECOGNITION AS A FUNCTION OF SENSORY MODE OF LEARNING FOR FIRST GRADE ENTRANTS

by

DOROTHY SHIRLEY MAC AULAY

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Word Recognition as a Function of Sensory Mode of Learning for First Grade Entrants" submitted by Dorothy Shirley Mac Aulay in partial fulfilment of the requirements for the degree of Master of Education.

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ABSTRACT

This study attempted to determine which of four methods--visual, auditory, kinaesthetic, or combination--was most effective for first-grade entrants in learning to recognize words.

The experimental group consisted of the eighty-two children entering the first grade of a large, public school in Saskatoon. The main test instrument used in the study --the <u>Learning Methods Test</u>--was administered individually. Each child was tested for immediate and delayed recall of the words he had learned to recognize by each of the four methods. Group and individual tests of visual, auditory, and motor aptitude were also administered in an effort to find corroborative evidence of preference for learning by a particular sensory mode. In addition to these tests, a group test of mental ability and screening tests for hearing and visual efficiency were given. Data obtained from class records and test results were analyzed by intercorrelations, comparison of means, and analysis of variance.

Testing revealed that although the girls were significantly older than the boys, intelligence levels for the sexes were equivalent. Significant differences were found to favor the girls in picture completion, sound blending, motor speed, and total scores for auditory, motor, and visual--auditory--motor aptitudes. In tests which

involved speed of perception the mean performance of the boys was consistently lower than that of the girls.

Statistical correlation revealed that performance on aptitude tests designed to measure visual, auditory, kinaesthetic-motor, and combined sensory modes of learning was highly related to level of intelligence but showed little or no relationship to chronological age. Performance on the tests of auditory aptitude (and to a lesser extent the other tests) appeared to be highly related to the differential development of the sexes especially as training and/or experience affects it.

In relating performance on the <u>Learning Methods Test</u> to tests measuring the same type of aptitude, it was found that the degree of relationship varied with: (1) the type of recall used as the criterion of learning, (2) the sex of the learner, (3) the purity of the measure for a specific perceptual ability, and (4) the sensory mode of learning involved. The children's immediate recall of the words correlated highly with their performance on tests that required responses of both recall and recognition as opposed to recognition (or identification) alone. Delayed recall of words learned by the Visual and Kinaesthetic Methods correlated significantly with the ability to hold in mind the wholeness of a figure while attending to its significant details (as measured by dot drawing, pattern

copying, and visual discrimination of letters and words). Learning to recognize words by the Auditory Method showed a low relationship with most of the tests of auditory aptitude but was very significantly related to auditory word discrimination.

There were no significant differences between the sexes in learning to recognize words by any of the four methods. Although the girls learned equally well by all methods, the Visual and Auditory Methods were significantly more effective for the boys than either the Kinaesthetic or the Combination Methods. There was no consistent relationship between chronological age and aptitude to learn by any of the four methods or in overall performance on the test. However, the class of younger children, who had approximately two months more school experience, learned significantly better by the Visual Method than the older children in the group. There seemed to be little or no relationship between level of intelligence and aptitude to learn by any one method. Because of what is implied for our current methods of teaching reading, it was interesting to note that the Combination Method did not prove to be superior to the other methods for any of the groups investigated.

In general, the study showed quite conclusively that certain children learned to recognize words more effect-

ively by one method than another and that no one method was best for all.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

CHAPTER PAGE

LIST OF TABLES

CHAPTER I

THE PROBLEM

I. GENERAL STATEMENT OF THE PROBLEM

Numerous studies over the past fifty years have sought to determine the effectiveness of various methods of teaching word-recognition skills. Each method has had its ardent supporters and each has been the subject of vigorous criticism. Some methods have been advocated as the panacea for most of the difficulties encountered by children in learning to read. These methods involve three basic sensory approaches--the visual, the auditory, and the kinaesthetic--which have been developed and used to help a child in identifying and recognizing the printed symbol. Auditory (or phonic), visual, and kinaesthetic elements may be involved in any method but when emphasis is given to one or more of these sensory approaches this emphasis becomes the differential between the methods. Comparative studies of the three basic methods have failed to yield any conclusive evidence. However, one fact clearly demonstrated by the research is that certain methods have been more successful with certain types of pupils than with others. In effect, these studies have been method-centered rather than learner-centered in evaluating methods of beginning reading instruction. The opposite approach would be to discover as much

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as we can about how individuals learn and then to determine the method or combination of methods which will facilitate maximum learning for a given type of learner. The question may not be which method is the correct approach to use, but rather, which children among those to be taught should be taught by which method.

Recent research in learning theory and perception has shown that children may differ in their modes of perceiving and that these differences may profoundly affect their aptitudes for learning by certain methods. It appears that some children may have "preferred senses" which lead to preferred modes of perceiving in learning. These children learn words and meanings more readily through visual processes, through auditory processes, or by kinaesthetic processes. Some investigators have referred to these types of learners as "visiles," "audiles," and "haptics" respectively. The present study has attempted to identify those children, who at the beginning of formal reading instruction, learn best through a visual, an auditory (or phonic), a kinaesthetic, or a combination method.

II. PURPOSE OF THE STUDY

The main purpose of this study is to determine the most effective teaching method or methods--visual, auditory, kinaesthetic, or combination--for teaching word

recognition to the various types of learners represented by the grade one entrants in the sample. The main test instrument to be used in the study in order to determine the children's best learning method and thereby the best teaching method for them will be the _Learning Methods Test_. This test is a series of standard teaching lessons in word recognition accompanied by tests of immediate and delayed recall for each of the four methods. Appropriate sections of four other tests will be used in an attempt to find corroborative evidence of preference for a particular sensory mode of learning (as measured by the _Learning Methods Test_). Three of these tests--the _Wepman Auditory Discrimination Test_, the _Visual Discrimination Tests_, and the _Monroe Reading Aptitude Primary_--are measures of reading aptitude, while the fourth--the _Pintner-Cunningham Primary_--is a test of mental ability. Auditory and visual screening tests will be given to ensure that the subjects fall within the normal range of vision and hearing.

More specifically the study will seek to answer the following questions:

1. To what extent can differences in children's aptitudes for learning by a particular sensory mode be measured by the _Learning Methods Test_?

2. To what extent is preference for a certain sensory mode of learning a function of certain pupil variables?

The variables to be investigated are: (1) sex, (2) intelligence, (3) chronological age, and (4) class placement.

3. What is the relationship between children's performance on the Visual, Auditory, Kinaesthetic, and Combination Methods of the <u>Learning Methods Test</u> and their performance on the other tests designed to assess the same sensory mode of learning?

III. DEFINITION OF TERMS

The following terms are defined as they will be used in this study:

1. The four learning (or teaching) methods used in the <u>Learning Methods Test</u>:

<u>Visual Method</u>. The child will be taught recognition of words by stressing exclusively the visual appearance and other visual clues and visual associations of the words.

<u>Auditory or Phonic Method</u>. Word recognition will be taught by emphasizing the sound qualities of the words.

<u>Kinaesthetic Method</u>. Because the children in this sample had not yet learned to write, the Kinaesthetic Method, as outlined in the manual of instructions, had to be adapted for use with them. The children will be taught to

recognize the words by tracing the words with their fingers, with chalk, and with a brush. The tracing will be done over words written with jumbo-sized chalk and with jumbo-sized wax crayon.

Combination Method. The other three methods will be combined for the fourth method. Word recognition will be taught by giving equal stress to the visual, auditory, and kinaesthetic qualities of the words.

2. Continuous Progress Policy. The Continuous Progress Policy, a policy which is operative in the primary grades of Saskatoon Public Schools, is based on the principle that not all children can learn the same material at the same rate. Children work steadily and continuously through the same units of work in the primary grades and may be promoted at any time of the year. Thus the brighter and more mature child may complete the work in one year less than the three years normally taken by the average student while the slower, less able, less mature child may require an extra year to complete the same amount of work.

3. Class placement. The term class placement will refer to the school's policy of assigning children to first-grade classrooms according to chronological age groups.

The school entrants (ranging in age from five years eight months to six years eight months) will have been divided into three age groups--the oldest, middle, and youngest--depending upon whether their birthdays fell within the first four months, the second four months, or the third four months of the calendar year. Because each teacher and each class will be different for this study we can assume that the classroom experiences of the children in the three classes will be different.

4. Immediate Recall. The number of words recognized and verbally recalled immediately after the teaching lesson for each of the four methods of the Learning Methods Test will be referred to as Immediate Recall.

5. Delayed Recall. The number of words recognized and verbally recalled twenty-four hours after the teaching lesson for each of the four methods of the Learning Methods Test will be referred to as Delayed Recall.

IV. HYPOTHESES

The following null hypotheses will be tested in the study:

1. There is no significant relationship between children's aptitudes to learn by any one of the four methods--Visual, Auditory, Kinaesthetic, or Combination--

of the <u>Learning Methods Test</u> and other tests designed to assess the same sensory mode of learning.

2. There is no significant relationship between chronological age, intelligence, or sex, and children's aptitude to learn by any of the following types of sensory learning: (1) visual, (2) auditory, (3) kinaesthetic, or (4) combination.

3. There is no significant relationship between children's aptitudes to learn by any one of the four methods--Visual, Auditory, Kinaesthetic or Combination--of the <u>Learning Methods Test</u> and any one of the following pupil variables: (1) sex, (2) intelligence, (3) chronological age, and (4) class placement.

V. PLAN OF THE STUDY

Because the <u>Learning Methods Test</u> has not previously been used with grade one entrants a small pilot study will be conducted. The purposes of the pilot study will be: (1) to establish adequate time allotments for the administration of the test with younger children and (2) to determine the suitability of, or the necessary modifications in, the teaching techniques--particularly those of the Kinaesthetic Method--for school beginners.

A series of tests will be administered to a group of grade one entrants in a Saskatoon Public School during

the first ten weeks of the 1963-64 school term. The group will consist of the children from three first-grade classrooms in a school assigned by the Administrative Department, Saskatoon Public Schools. With the exceptions of the group mental ability test, the auditory screening test, and the part of the visual screening test to be administered by an optometrist, all other group and individual tests will be administered by the investigator.

The main test instrument--the Learning Methods Test --is composed of four principal parts and will be administered individually to each of the children in the sample. The four parts of the test are: (1) the pre-test of word recognition, (2) the teaching of ten words by a different method on each of four consecutive days, (3) a test of immediate recall for each method, and (4) a test of delayed recall for each method.

All tests will be marked and recorded by the investigator. The data obtained from the class records and the test results will be programmed at the Computer Centre of the University of Alberta in Edmonton.

VI. LIMITATIONS OF THE STUDY

The following limitations must be acknowledged with regard to the design of the present study:

1. Sample selection. The study will be delimited

to the grade one entrants of one Saskatoon Public School. It is possible that this selection may limit the socio-economic level of the sample.

2. <u>Chronological age range</u>. Because of grade one entrance requirements the chronological age range will be limited. Except in cases of extenuating circumstances--such as prolonged illness--entrance to first grade in Saskatoon Public Schools is limited to the beginning of the school term in September of each year. Children must reach the full age of six years by the last day of December in the year in which they enter first grade. Therefore, the chronological age span will be limited to the maximum of one year, from five years eight months to six years eight months.

3. <u>Kindergarten experience</u>. Since there are no kindergartens operated by the Saskatoon Public Schools not all children attend kindergarten and the effect of kindergarten experience (i.e. at privately operated schools or those sponsored by some organization such as a church) can not be systematically investigated.

Any interpretation of the findings of this study must be undertaken with these limitations in mind.

VII. NEED FOR THE STUDY

If, indeed, pupils do have a preferred sense leading

to a preferred mode of learning, whether this be innate or acquired, then it would seem essential that initial grouping and instructional procedures take account of these individual differences. Commonly used reading readiness and primary mental ability tests have attempted to measure these differences to some extent, but until very recently no test has attempted to place equal emphasis upon the measurement of aptitude to learn by each of these three sensory approaches. Instructional techniques and materials as well as testing instruments have tended to emphasize the visual-verbal aspects of learning. The main testing instrument in this study, the Learning Methods Test, was designed to determine the method or combination of methods by which pupils learn to recognize words most effectively. Insofar as it is possible, each distinct method has sought to maximize one of the elements of word recognition--visual, auditory, or kinaesthetic--while minimizing the other elements. The exception to this is the fourth or Combination Method which endeavours to place equal stress on the three elements. If, then, the efficacy of this instrument, in identifying children with decided preferences for distinct sensory modes of learning, can be demonstrated, a significant contribution will be made to the criteria by which children are grouped for beginning reading instruction. It is hoped that the study may also contribute to our knowledge of how children learn.

CHAPTER II

RELATED STUDIES

The abundance of research in the area of identification-recognition leaves little doubt that this process within the reading act has received more attention than any other throughout the years. This is probably natural since the primary task of beginning reading instruction is to assist the child in identifying and recognizing letters, syllables, words, phrases, and even short sentences. The task is not a simple one. Recognition literally means knowing again. Thus previous experience must be associated with a word or phrase before retention is complete. However, although meaning can assist recognition and vice versa, there is no one-to-one relationship, as Betts (1953) has pointed out. Other factors complicate the process and although studies in word perception have suggested how word recognition takes place, there is evidence that the precise nature of the process may be dependent upon factors within: (1) the individual learner, (2) the material itself, and (3) the method of presentation.

Prevailing theories of word perception or the particular interest or bias of the researcher have tended to determine the factors investigated in the studies of word recognition. Consequently, some investigators have focussed on the comparative effectiveness of various

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methods of instruction by looking at individual and group results. Others, primarily interested in one of the perceptual abilities most closely related to reading, have examined the role of visual, auditory or kinaesthetic perceptual abilities but little attention has been directed to the interrelationship of these abilities. Very few investigators have sought to determine characteristic patterns of perceiving or the interaction of these with various modes of presentation. Studies, representative of these types of investigations, have been reviewed in this chapter and were selected because of the significant contributions to our understanding of the factors that may predispose a child to learn to recognize words more effectively by one sensory mode of learning than another.

The chapter begins by examining the roles of visual, auditory, and kinaesthetic perceptual abilities in determining a child's best learning method. These sections are followed by a review of the studies related to characteristic modes of perceiving in general and sensory modes of learning in word or symbol recognition. Finally, a section has been devoted to sex differences in reading readiness which may predispose a child to learn best by one sensory mode of learning.

I. STUDIES RELATED TO VISUAL PERCEPTUAL ABILITIES

The most extensive body of research in perception, as it relates to the reading process, has been in the area of visual perception. Probably this is a reflection of the conviction expressed by Schonell (1952) to the effect that, of all the factors which contribute to a young child's accurate recognition of words, the ability to deal with the visual pattern is the most important. However, the review of the research will be limited to a few well designed studies relating the child's visual perceptual abilities to success in learning to recognize words.

Goins (1958) used a variety of visual perceptual tasks with non-verbal materials and intercorrelational techniques to find the relationship between competence in visual perception and achievement in first-grade reading. Although the observed pattern of intercorrelations and the results of factorial analysis indicated the existence of a general power of visual perception related to reading, she found wide individual variations among the first-grade pupils in competency of performance. Goins identified two factors of visual perception related to reading. The one factor, referred to in other studies as "speed of perception," was described by Goins as the ability to hold in mind a simple perceptual Gestalt during rapid (or timed)

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The most [illegible]

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of visual perception. [illegible]

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perception and calls only for simple discrimination of likenesses and differences. The second factor, which she termed "strength of closure," pertains to the ability to hold in mind the wholeness of a figure against distraction or while attending to the significant details. Both factors correlated significantly with reading ability. However, the second factor was a better predictor of success in beginning reading although it is not usually measured in tests of reading readiness. The bimodality of the scores on Goin's test of Picture Sequences and observation of individual children as they took the test, confirmed that two distinctly separate types of approach were used. One "type of perceiver" (those with inferior scores) looked at each item in order and then attempted to match it with another in the group. Those children with superior scores looked at the nine pictures as an entity, while concomitantly attending to the separate parts, and thus more quickly found the two identical pictures. The tendency towards bimodality of scores was evident but to a lesser extent on Goin's test of Reversals which also involved "strength of closure." Contrary to the findings of Renshaw (1945), Goins did not find that skill in visual perception improved through training with the tachistoscope.

Vernon (1957), Gesell (1953), and Frostig and her associates (1961) have stressed the varying maturational

rates of normal visual perceptual powers in individual children. They have noted that the period of maximum visual perceptual development normally occurs between the ages of three and one half and seven and one half years--that is, when the child is in kindergarten or the first two grades of school. Triggs (1959) and others have pointed out that the problem of obtaining pure measures of visual discrimination--relatively free of the influence of intelligence and speed--has created difficulties in demonstrating its relationship to reading. However, the study of Goins, cited earlier, and the summary of investigations of Vernon (1959) have shown that performance on visual discriminatory tasks--such as pattern copying--which closely resemble the task of letter and word discrimination, are closely correlated with success in beginning reading. It seems obvious that a child's maturational level in visual discrimination will significantly affect his ability to make use of visual cues in reading.

The ability to recall a visual image or mental picture of a word form is closely related to the habit of scrutinizing word forms to remember details and is a very important factor in acquiring a sight word vocabulary. Perhaps the fact that this ability may be limited by powers of visual discrimination accounts, in part at least, for the paucity of studies that have investigated this

aspect separately. Johnson (1959) took the extreme position that a child with defective visual memory would never learn to read. Harris (1961) considered that the child who had difficulties with visual imagery might be helped by reinforcement of visual cues with cues from another sense modality (auditory or motor). Radaker's studies in visual imagery as it related to reading (1962) would indicate that this ability responds to training and the generalized effect transfers to other areas as well as reading. Probably the difficulties encountered when investigators have attempted to separate the influence of sensory stimulation from the cognitive aspects of this dimension of the visual perceptual process may have partially accounted for the lack of definitive statements with regard to its relationship to the reading process.

The degree of visual acuity, possessed by an individual, may affect both discrimination and memory but a high degree of acuity does not guarantee a high level of the other two abilities. The extensive research of Gesell (1953) has shown that visual acuity is partly a product of maturation, that far-point acuity is superior to near-point acuity in children, and that near-point acuity may not be fully developed until the eighth year of a child's life. Cultural and educational forces may contribute to the pattern of development but their influence is limited

by the maturational individuality of the child. A review of the research by Robinson (1946) and Robinson and Huelsman (1953) has revealed that there is a relationship between certain visual defects and reading achievement and that this is most significant at first-grade level. The defects correlating most significantly with reading achievement were depth perception, fusion, and near-point acuity. These findings were confirmed by Park and Burri (1943), Eames (1953) and Hinds (1959). Most investigators agreed that, when corrective treatment is given and methods of instruction are adjusted for those with gross defects, development in reading proceeds normally.

<u>Summary</u>

There is general agreement that visual perceptual abilities are of prime importance to the identification-recognition process of the reading act. The interrelationship of the various dimensions of visual perception--discrimination, memory, and acuity, makes it difficult to estimate the relative importance of each. Apparently, differential maturation affects the development of discrimination and acuity but there is insufficient evidence to be able to make any generalizations with regard to visual memory. The findings imply that, for some children entering the first grade, learning to recognize words by a method

which places emphasis on the visual components of the words would be considerably more difficult than for others.

II. STUDIES RELATED TO AUDITORY PERCEPTUAL ABILITIES

Russell and Fea define the role of auditory perception in learning to read by comparing auditory perception with visual perception:

> It is safe to state that the role of auditory perception is a minor one since, in theory at least, it is possible to see, recognize, and to understand (i.e. to go through the complete reading process) without auditory perception, but reading without visual perception is a negation of the word (1963, p. 873).

Duggins (1958) would not agree with Russell's statement. She maintained that a reader, in reacting to the symbols on a printed page, brings his visual and auditory experiences simultaneously to the formation of a perceptual pattern. In light of this, she considered it maturationally sound to give precedence to the development of auditory perception in initial reading instruction. However, she criticized both the "look-and-say" and the "phonics" systems because they were based primarily upon the vocal (speech) acts rather than the imagery required of the acts.

Auditory acuity, the ability to hear sounds, may affect the child's ability to perceive correctly the speech sounds of others. Henry (1947) demonstrated that the threshold of hearing, even for pure tones, may be higher

for children of apparently normal hearing than for adults. Kennedy (1942) also found that the auditory acuity of six year-old children was lower at almost every frequency than that of the eight year-old children. Both investigators noted that high-frequency loss of hearing tends to affect the discrimination of consonants which in English carry the intelligibility of the language. Bond's study (1938) showed a statistically significant difference between good and poor readers in acuity, as well as discrimination and memory span, and this was especially significant when the children with auditory defects had been taught by a phonic method. Witty and Kopel (1936) concluded that gross auditory defects are only operative in creating reading disabilities when the method of instruction has not been adjusted for their loss of hearing ability.

Wepman defined auditory discrimination as:

> ... the ability to recognize the different phonemes of spoken language even when the phonetic structures, especially the soundwave patterns, of the sounds to be discriminated are highly similar in nature (1960, p. 326).

In his research on auditory discrimination and its relationship to speech and reading he has demonstrated that this auditory perceptual ability has its own rate of development and may continue to mature through the eighth year of life. Wepman also found a significant relation-

ship between auditory discrimination and success in beginning reading. These findings were supported by those of Thompson (1963) in her longitudinal study of auditory discrimination. Both of these investigators urged the early testing of this ability and a slow introduction to phonics for those children whose scores fell at the lower end of the distribution. They suggested that training in discrimination will speed up the developmental process or at least prepare the child for better discrimination when he is capable of it. Harris (1961, p. 231) and Durrell (1956) maintain that specific perceptual training will eliminate most difficulties because the child has not learned to pay attention to details and still retains the uncritical and unanalytical attitude common in preschool children.

Wepman (1961) demonstrated that auditory memory, the ability to remember sounds, was developmental and, of the components of hearing, discrimination and memory were the latest to mature. Poling (1953) and Johnson (1955), among others, found retarded readers to be significantly inadequate in auditory memory span. A recent Alberta study by Reid (1962) found a significant relationship between auditory memory and reading abilities of first-grade children.

Sound blending also involves auditory memory and is

an important ability in any phonic approach to reading. It is a form of auditory closure. Vernon (1957) considered that the inability to blend sounds was due to lack of attention but Lantz (1956) suggested that it may be accounted for in a different way. Her study revealed that some individuals listen either to the content of speech or to the method of delivery and that concentration on one could decrease perception in the other with the result that blending cannot be accomplished. The investigations of Chall et al (1963) showed that auditory blending ability was positively correlated with reading ability and increased steadily with age. They suggest that poor auditory blending ability may be due to a neuro-physical defect or a developmental lag.

Summary

There appears to be considerable evidence to support a differential maturation rate in auditory perceptual abilities. However, most investigators agree that, except in the case of gross or innate defects, the process of maturation may be speeded up or aided by specific perceptual training. It would seem that beginning approaches to reading which emphasize learning through other sensory modalities would be more profitable for children who show a lack of maturation in auditory perception or who have gross auditory defects.

III. STUDIES RELATED TO KINAESTHETIC PERCEPTION AND ITS IMPLICATIONS FOR THE TEACHING OF READING

Kinaesthetic perception has generally been considered secondary to visual and auditory perception. Undoubtedly, extreme cases of sensory impairment, such as that of Helen Keller, and the use of typewriters and braille with the blind, have accented the importance of the kinaesthetic-tactile approach to learning. It is possible that a method which emphasizes this sensory avenue of learning may be the most successful with some children and that all children may profit by a greater use of kinaesthetic reinforcement in some types of learning activities or at particular stages of the learning process. The literature will be reviewed with specific reference to the role of kinaesthetic perception in learning to read.

The kinaesthetic method of teaching reading has been elaborated most fully in the writings of Fernald (1943) and Fernald and Keller (1921). Fundamentally, the Fernald-Keller method consisted in having the child trace with his first two fingers over a word written in large manuscript on the blackboard or with crayola on cardboard. As the child traced, he said the word in syllables and repeated the process until he could write it from memory. Words were selected by the child from his own

experience so that the method resembled a modified experience approach with visual, auditory, tactile and kinaesthetic modes of learning being emphasized. Fernald described four stages of progress: (1) tracing the word in script, (2) writing from script without tracing, (3) writing from print only, and (4) recognition of words without printing. Some of Fernald's cases progressed through all four stages with words, phrases, and sentences but some required this approach only for single words and may not have required all the steps. Fernald believed that all children could profit by such an approach.

Several reading authorities, including Schonell (1952), have emphasized that writing and tracing are essential experiences in revealing to pupils the function of words as indicators of real situations (as in labelling drawings) and of acquainting them with word patterns. The Calvert Method, described by Anderson and Dearborn (1952), held that writing should begin at the same time as reading in order to develop a strong kinaesthetic feeling for words. Hildreth (1963) also made a plea for early writing as an aid to reading--particularly to reinforce word recognition and discrimination and to establish sound-symbol associations of phonic instruction.

Shea (1958) made a case for the kinaesthetic method and gave numerous examples of how it may be applied in the

modern classroom. She noted that performance intelligence scores are an integral part of many group and individual tests of mental ability but she deplored the fact that these performance abilities are going unchallenged and undeveloped because kinaesthetic learning has not been thoroughly investigated for method, technique, and application. Shea acknowledged that some children learn best through the sense avenues of sight and hearing and need kinaesthetic devices only to indicate their ability to apply their abstract knowledge, while others need longer periods of kinaesthetic reinforcement until the transition from concrete to abstract learning has taken place. She contended that a third group will always need concrete learning and kinaesthetic devices and will always perform best in these activities. Shea felt that the statements from anthropology to the effect that as man learned to use his hands, the size of his brain increased, have greater implications for the methodology of reading instruction than have heretofore been realized. She concluded by pointing out that kinaesthetic learning is not a panacea for all learning difficulties but deserves to be investigated more fully:

> Undoubtedly the greatest handicap to such study has been the belief that kinaesthetic learning is a thing apart and cannot exist side by side with the academic, but once this is dissipated, kinaesthetic learning bids fair to come into its own in a happy and united relationship with all learning forms (p. 158).

Roberts and Coleman (1958) conducted a carefully controlled experiment to test Fernald's assumption that, for many pupils, the development of a kinaesthetic background is necessary before they are able to perceive visual sensations stimulated by printed words. They used two matched groups--an experimental group of 27 reading failures and a control group of 29 normal readers--and compared them on a test of visual perceptual acuity and with respect to learning efficiency under conditions of visual presentation alone and under visual-kinaesthetic presentation of nonsense syllables. They found that reading failures were: (1) deficient in visual perception, (2) less efficient than normal readers in learning new materials when visual cues alone were used, and (3) more efficient in learning new materials when kinaesthetic elements were added to purely visual ones. The first and second findings were significant beyond the .01 level of confidence and the third finding was significant beyond the .05 level of confidence. In this experiment normal readers, as a group, were not significantly aided by the addition of kinaesthetic elements to visual ones.

French (1953) devised a test of kinaesthetic recognition with cues restricted to hand and arm movements. Eight to ten year old blindfolded children used a stylus to trace a maze of different shapes, first tracing the

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original or model and then the two choices--one of which they selected to match the original. The experimental group (N=45)--oral reading retardates and the control group (N=45)--readers of normal oral reading ability were matched for means and standard deviations of mental ability and chronological age. The following variables were held constant: (1) school attendance, (2) sex (males only), (3) race, (4) handedness, and (5) the absence of gross auditory, visual or motor defects. Because the chi-square treatment of the data showed a lack of strict normality of distribution in the two groups, a method of percentage overlap was used and the critical ratio was significant beyond the .01 level of confidence. French felt that these findings tended to substantiate the hypothesis that oral reading retardates are inferior to non-retarded readers in kinaesthetic recognition. He suggested that: (1) perhaps children who have difficulty in learning to read are unable to retain kinaesthetic traces so that such traces can become part of the general associative complex leading to word recognition and (2) the associative process itself may be deficient in reading retardates.

Other investigators believe that the kinaesthetic method should be reserved for those who can not learn through visual or auditory perception. Harris (1961) and

Bond and Tinker (1957) noted the phenomenal success claimed by Fernald (1943) in the use of the method with extreme cases of reading disability and questioned whether the kinaesthetic factor was really the most important factor in its success. These authors contended that the value of such an approach may well be due to its emphasis upon: (1) left-to-right sequences of perception, (2) the focus of the child's attention to the visual structure of words with simultaneous sound-symbol association, (3) phonic skill and the use of context clues in word attack, (4) the strong motivation provided by the experience approach utilized, and (5) additional sensory cues in word attack. Robinson (1948) and Gray (1961) emphasized the value of a kinaesthetic approach for those children who lack visual efficiency in distinguishing likenesses and differences in picture and word forms. Gates (1935) considered it primarily a technique in word analysis:

> It is the writer's belief, however, that the value of this kinaesthetic approach lies primarily in its function as a means of demonstrating the direction of attack and of calling attention to details, rather than in any intrinsic or otherwise significant kinaesthetic influence (p. 368).

Morris (1958) criticized exclusive use of the method because: (1) it tends to discourage independent word-recognition techniques and (2) residual arm and lip movements hamper speed and fluency in later reading. Both Morris and Eberl (1953) feared that over-emphasis

of such a sensory approach may interfere with visual or auditory perception by dividing the child's attention. Fernald's hypothesis that certain children are defective in visual and auditory imagery but rely greatly upon tactile and kinaesthetic imagery was attacked by Vernon (1957) who maintained that it has never been possible to prove that a lack of the appropriate imagery can completely prevent the development of any form of skilled act. Vernon granted, however, that a tendency to rely on tactile-kinaesthetic, rather than on visual and auditory imagery, might be a predisposing factor to reading difficulty.

Summary

The dearth of research-based evidence to support or negate the effectiveness of a method which places major emphasis upon kinaesthetic perception in learning to read leaves us with many unanswered questions. The proponents of such methods have, for the most part, used either empirical observations or a case-study approach to support their claims and little of the data has been subjected to any rigorous statistical treatment. It is possible that the success claimed for such methods may be due to uncontrolled or intervening variables rather than the kinaesthetic factor itself. Most of the studies have investigated the effectiveness of kinaesthetic methods with children who have already failed to learn to read by other methods

so that the novelty of the approach may be an important factor. Apparently, the relative efficiency of kinaesthetic perception as compared with visual, auditory, or multi-sensory perception, has not been tested with children who are just beginning to learn to read.

IV. STUDIES RELATED TO CHARACTERISTIC MODES OF PERCEIVING AND PERCEPTUAL TYPES

Experiments devoted to studying individual differences in perception have given evidence to support the existence of perceptual "types" or characteristic modes of perceiving within individuals. Vernon (1952 and 1962), in reviewing the research in this area, suggested that there is ample evidence to support characteristic modes of perceiving but she questioned the evidence as to the association between perceptual differences and personality typologies. She further suggested that these "different modes of perceiving may be partly a function of maturity, partly of social and educational background; but may also have some temperamental basis" (1952, p. 250). Her own investigations had tended to show that methods of perception depended on the type of material presented and the method of presentation.

Jenkinson (1962) drew attention to the work of psychologists (most of whom were German) who early in the

century postulated that perceivers might be classified according to temperamental set or attitude. The most important of these classifications, because of what it implies for the teaching of word recognition, was the one which typed perceivers as "synthesizers" and "analyzers." The former tends to see the perceptual field as an integrated whole, without much regard for detail, while the latter concentrates on isolated or unrelated detail without seeing the pattern or configuration as a whole. Schmidt-Durban, as cited in Vernon (1952, p. 248), claimed that there existed a "plastic" type intermediate between the analytic and synthetic type and possessing a higher level of structure.

The experiment of Petty (1939) in the area of visual perception and the more recent work of Goins (1958) --cited earlier in the chapter--have given extra support to the postulated existence of perceptual "types." Petty, following a study of eidetic imagery and susceptibility to illusion, concluded that children who had high reading but low drawing ability exercised a highly synthetic perception, whereas those with low reading but high drawing ability succeeded in the latter because of their attention to detail, but were unsuccessful in reading because of an inconsistency in selecting details. She suggested that such tests may be useful in determining what method would

be most successful with a particular child. Petty inferred that the subjective perceiver, who used a synthetic approach, might better be introduced to reading by a method which stressed recognition of words by their total character, while the objective perceiver--the analyzer who concentrated on details--might be taught by a method, such as phonics, which stressed recognition of words by details.

There is some evidence in the literature that children may be typed according to the sensory modality by which they learn best. De Hirsch (1962) described a prediction study then in progress at the kindergarten level. This study was designed to get an impression of the children's maturational patterns in the visual, auditory, and tactile-motor modalities. An interim report showed that some of the children were far advanced in one modality and quite slow in another, while others, in spite of good reasoning abilities, seemed to mature slowly in all modalities. De Hirsch emphasized that although most children learn to read regardless of the method of teaching, there are some children for whom specific teaching procedures are crucial and only by studying the various sensory modalities differentially will we find out what type of learning a child can use best. Helen M. Robinson at the University of Chicago is currently conducting an

eight year investigation which will evaluate pupil progress in reading following early identification of aptitudes for learning by a certain method (visual, auditory, kinaesthetic, or combination in character) and provision of instruction geared to these aptitudes. Wepman (1960) noted this differential maturation and emphasized the need to individualize instruction, at least to the point of grouping visual and auditory learners separately at the onset of reading instruction until such time as their developmental processes came into balance.

Lowenfeld's work in the field of art (1945) revived an earlier popular theory of differing imaginal types and his experiments have illustrated the relationship of preferred imagery to manner of perceiving. He found significant evidence of "visual" and "haptic" types of perceivers, the former referring to those individuals who perceive relatively more easily by vision or visual imagery and the latter referring to those who perceived best through kinaesthetic or tactile sensory modes or imagery.

Summary

The research indicates support for the hypothesis that individuals have characteristic modes of perceiving but these may be specific to a particular manner of presentation, the directions given the subjects, or the

materials presented to them. Much of the research with regard to the influence of temperamental differences upon patterns of perceiving has been carried out with adults in a laboratory setting and there is some doubt as to whether these patterns would be consistently maintained in a typical reading situation. Age, intelligence, training, and social background seemed to have influenced the development of these sets or attitudes and to what extent they are a product of innate abilities or maturational development remains an open question.

Few studies have investigated children's individual endowments in terms of the various sensory modalities and how these are affected by maturation or training. Most of the studies are still in progress and no final reports of the findings are available.

V. STUDIES RELATED TO SENSORY MODE OF LEARNING IN SYMBOL OR WORD RECOGNITION

The studies that have investigated the relative merits of various sensory modes of learning have, for the most part, used paired-associates or nonsense syllables as the learning task and most of these experiments have been with children who were beyond the primary level in school. The studies of Lockard and Sidowski (1961), Otto (1961), and a more recent study completed in Alberta, by

Collet (1964) are examples of this type of study. In general, the findings of the first two studies concurred with those of Collet--that a multi-sensory approach to symbol learning was more effective than any one sensory approach. The authors acknowledged that the conclusions drawn from these findings can not be generalized to learning words.

The study of Mills (1956) was more realistically related to the classroom teacher's task in teaching word recognition. Mills, who designed the Learning Methods Test (the main test instrument of the present study), used this test to determine which method--visual, phonic, kinaesthetic or combination--was the most effective learning method for his sample of fifty-eight children. His sample of nineteen girls and thirty-nine boys were from the first, second, and third grades of five Florida public schools. They ranged in age from seven to nine years and from 65 to 120 in intelligence quotient (as measured by an individual test). Mills used matched-pairs of boys and girls and a special research design, employing the t-test, to determine the effect of the sex variable. Because he found no differences between the sexes in learning to recognize words, the effects of the variables of chronological age and intelligence on learning methods were not investigated separately for the sexes. Intelligence proved

to be the most significant variable in determining the number of words learned by any child in one lesson. On the basis of the findings from an analysis of variance, Mills was able to draw certain conclusions about the relative effectiveness of the methods for different children. The phonic method was significantly inferior for the children of his lowest intelligence group and the kinaesthetic method appeared to be best. For the children in the high group of intelligence, the visual method proved superior to the kinaesthetic method. Seven year-olds learned best by the visual method and least effectively by the kinaesthetic method. The kinaesthetic was significantly better than the phonic method for eight year-olds. Mill's study showed quite conclusively that different children learned to recognize words more efficiently by some teaching methods than by others and that no one method was best for all.

Summary

The paucity of studies in this area precludes the making of any definitive statements with regard to the relationship between sensory modes of learning and the teaching of word recognition. However, it was considered important to include the study by Mills (1956) because of its similarity to the present study.

VI. STUDIES RELATED TO SEX DIFFERENCES IN READINESS FOR AND ACHIEVEMENT IN BEGINNING READING

The literature abounds with studies that have investigated sex differences in various aspects of reading ability from pre-school to college level inclusive. However, for purposes of the present study the review has been limited to those studies concerned with measures of readiness for and achievement in beginning reading.

Wilson, Burke, and Flemming (1939) studied progress of kindergarten and primary-grade children between the ages of four and eight years in the Horace Mann School of Teachers' College and found that there was little difference between the sexes in general reading ability, but the boys made more mistakes in letter recognition, and were more prone to reverse both letters and words. Wilson et al considered that the greater physiological maturation and social adjustment in the girls gave them an advantage in learning to read.

Samuels (1943) investigated reading readiness and achievement in a random sample of 216 boys and 237 girls drawn from Phoenix Public Schools. The subjects entering first grade were compared on six measures of prediction: chronological age, mental age, intelligence quotient, the Monroe Aptitude Test (Primary), drawing ability, and

teacher ratings after two weeks of observation. In all of these measures, except chronological age, Samuels found girls to be superior to a degree that was statistically significant. The subjects were retested for reading achievement at the end of grade one when the girls excelled the boys by four months in reading age. Samuels concluded that administrators should plan more adequate measures of reading readiness and that further investigations were needed to determine the true nature of the sex differences. He suggested that linguistic ability, rate of physiological development, appeal of the school situation in general, content of the reading material, or the teaching techniques might be investigated as contributory factors.

Carroll (1948) analyzed the results of five tests of reading readiness involving one thousand children. Throughout the whole series the girls were superior in 24 tests while the boys excelled in 14 tests. All significant differences favored the girls and these differences were in visual perceptual abilities. Carroll acknowledged that, since she was only analyzing data already available, she had been unable to exercise any strict controls over selection of samples or administration of the tests. She advised that on future replications of the experiment, groups should be matched on the basis of chronological age, mental age and background of language or general

experience.

A carefully designed experiment by McLaren (1950) sought to determine the effect of sex differences in reading attainment in the infant division of Glasgow Primary Schools. The subjects (N=1080) were selected so that each of forty-five schools (representing two methods of reading instruction and various levels of socio-economic status) sent twelve of each sex at each quarter-year age range from five to eight years old. She found no significant differences between the sexes on tests of reading comprehension and word recognition.

Konski (1951) explored differences among first-grade pupils in reading readiness and achievement. In this investigation boys and girls from 73 to 78 months of age, at first-grade entrance, were compared in twelve selected readiness areas which included: visual discrimination, articulation, verbal facility, length and number of spoken sentences, memory span for related ideas, personality and problem tendencies, and certain measures of physical development. The findings showed no significant differences between the sexes in any of these areas. In contrast, at the end of the first grade, when these children were measured by four tests of reading achievement, the girls were found to be superior to the boys to a degree that was statistically significant.

Pauley (1951) compared the test results of 1,502 second-grade children on the Gates Advanced Primary and found that although the girls' mean chronological age was two months lower than that of the boys, the former achieved mean scores two months higher than the boys. Pauley then prepared age-grade tables for every age and grade group in the Tulsa elementary schools (N=28,610) and found that on the average, boys were 3.57 months over-age for their grades as compared with 2.77 months for the girls. He concluded that the legal entrance age for boys should be raised. It would seem that Pauley, in drawing this conclusion, failed to consider the factor of individual differences within the sexes or that some aspects of reading readiness respond to specific training.

In order to determine whether separate norms should be established for the sexes, Prescott (1955) selected from a population of 14,959 Metropolitan Readiness Tests and analyzed 400 tests completed by each sex. Although the differences on mean scores favored the girls, these differences disappeared when chronological age was held constant. Prescott noted that there were more over-age boys and under-age girls in grade one, and that the latter achieved higher ratings, while average-age boys were slightly superior to girls of the same age. On the basis of this research he concluded that separate test norms

were impractical, but expectancy tables should be prepared at the local level and this might result in different admission ages for the boys and girls entering grade one.

King (1959) investigated the relative merits of listening and reading comprehension for children of primary school age in London. The intelligence factor was held constant. The girls surpassed the boys on eight out of ten visual presentations, but only two of these differences were significant, while in auditory comprehension, the only significant difference favored the boys.

Balow (1963) compared equal numbers of each sex (N=302) for reading readiness at entrance to the first grade and on reading achievement five months later. He found significant differences favoring the girls on both measures. When reading readiness was held constant, the differences between the sexes in achievement were too small to be significant. Of the four subtests of the readiness test, only the visual perception tests (word-matching and word-card-matching) resulted in significant differences. Balow concluded that the data seemed to support a non-maturational theory of sex differences in learning to read.

Surveys of reading achievement which have utilized large samples and comparable forms of one test with primary, intermediate, junior and senior high school

students, have shown that sex differences favoring girls tend to be most significant at late primary level and that though the girls' superiority continues through intermediate and junior high school, it does so on a declining basis and tends to disappear in late high school. This is borne out in the findings of Hughes (1953), Stroud and Lindquist (1942), Sly (1960), and Gates (1961).

Summary

On the basis of the above research there seems little doubt that sex differences in reading readiness and achievement do exist, and that these differences give girls an advantage in learning to read. However, the evidence remains equivocal as to which factors contribute most significantly to these differences, whether the differences are innate or acquired, and whether specific training at school entrance would tend to make the differences disappear. Theories of differing rates of physical, mental and social maturation, perceptual development, linguistic ability, interests, and motivation have been advanced as causal factors. It would appear that more definitive statements as to the causes and extent of these differences must await further research in which more precise and valid instruments are used and more rigid controls are applied. It is possible that present day

investigations into environmental factors such as differential appeal of the reading content or teaching techniques, perceptual factors such as characteristic patterns of perceiving or types of perceivers, and even neurological factors such as the incidence of minimal brain damage among boys may provide further insight into the problem. Meantime, a lack of agreement among investigators as to the nature and extent of these differences suggests that differences within the sexes are at least as important as the differences between the sexes.

VII. GENERAL SUMMARY

The review of the research, regarding the roles of visual and auditory perceptual abilities in learning to recognize words, has been oriented toward the differential development of vision and audition--within and between individual children--which may predispose a child to learn more or less effectively by one of these sense modalities. Because of the interrelationship of discrimination, memory and acuity, in visual and auditory perception, the level of development in one ability may impose limits upon the development of the other. Thus the child can not discriminate sounds he cannot hear, and when he can not discriminate and understand he will not remember. The difficulty of separating the cognitive aspects from the

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sensory stimulation involved in each ability has created difficulties in the measurement of each. However, the research has shown clearly that children, at first-grade entrance, differ widely in their levels of development in each sensory area (i.e. auditory or visual) and in the various perceptual abilities within each. A child with a low level of development in visual perception (whether this be due to maturation, innate defects, or lack of experience in visual tasks) may have a much higher level of development in the auditory area, for seldom do two sense modalities reach the same level of development at the same time in any individual. It would appear that for this type of child, at beginning reading level, an approach to word recognition which stresses the auditory elements of the words may be the most effective.

The role of kinaesthetic perception in the reading act has been much less clearly defined than that of the visual or auditory. Most of the reading authorities agree that while kinaesthetic cues can be used to reinforce visual or auditory cues there are few children for whom a kinaesthetic approach to reading is the most effective. Some have considered the effects of a kinaesthetic approach to be inhibitory to auditory and visual perception. Its value as a remedial measure has been more clearly demonstrated than its use as an approach to

beginning reading.

There is some evidence to support the existence of perceptual types or characteristic modes of perceiving. To what extent these may be a function of age, maturation, training, experience or intelligence is not clear. Classifying perceivers as "analyzers" or "synthesizers" according to temperamental set or attitude, or as "audiles," "visiles," or "haptics," according to the sensory modality through which they learn best, are both important classifications in their implications for the teaching of word recognition. If future research bears out the limited findings with regard to "perceptual types" and further indicates that these are maintained by certain children in a typical learning situation it would imply that techniques of instruction must be differentiated for these children. Thus, while not neglecting the development of other perceptual abilities, it would seem that: (1) the development of word recognition for a "visualizer" would stress a sight vocabulary as a beginning approach, (2) that the "analyzer" who is also an "audile" could profit better by a phonic approach, and (3) that the child who displays an aptitude for learning best through a kinaesthetic sensory avenue would require kinaesthetic-motor reinforcement.

Studies which have attempted to relate the type

of sensory approach (visual, auditory, kinaesthetic, or combined) to success in learning symbols have, for the most part, used non-meaningful material. Because of this, the study by Mills (1956), which tested the relative effectiveness of four sensory approaches to word recognition, is a promising beginning and may point the direction for further studies. Mills showed quite conclusively that no method was best for all children and that some children learned significantly better through one sensory mode of learning than another.

The sampling of studies related to sex differences in readiness for, and achievement in, beginning reading leaves little doubt that girls begin school with certain advantages over boys. Theories of differing rates of physical, intellectual, and social maturation; perceptual development; linguistic development; and differing interests have been advanced as possible reasons for the differences. The evidence from the research clearly implies that we must take cognizance of the differences between the sexes in their readiness to begin reading.

The research findings, reviewed in this chapter, indicate the need for determining, as accurately as possible, the level of children's perceptual development in each sensory area before selecting techniques of instruction in word recognition for them.

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CHAPTER III

EXPERIMENTAL DESIGN

This chapter will describe the pilot study, the testing population, the testing instruments and their use, and the statistical treatment of the data obtained.

I. THE PILOT STUDY

Because the main testing instrument, the <u>Mills Learning Methods Test</u>, had not previously been used with grade one entrants, a small pilot study was conducted in the month of May, 1963. The purpose of the preliminary study was to determine (1) the suitability of the testing procedures and (2) the time allotments for the teaching-testing schedule of the present study.

Preliminary arrangements had indicated that the available testing population was unlikely to exceed seventy pupils. On this basis it was considered that a sample equal to ten per cent of the testing population would be sufficient for purposes of the pilot study. In addition it was difficult to secure a vacant classroom in an area of Saskatoon similar to that in which the actual experiment was to take place and to find children who were free to participate during the particular week when a classroom became available. However, seven children (three boys and four girls), four of whom had never

attended kindergarten, participated in the one-week study.

The experiences of the pilot study revealed that certain adaptations would be necessary in order to use the Mills Learning Methods Test with grade one entrants. These children could not be expected to be familiar with (1) written letters or words, (2) the sounds of the letters, or (3) their reproduction in writing. The above-mentioned limitations, in addition to problems of immature eye-hand co-ordination made necessary an adjustment in the time limits. Consequently, the training periods were extended from fifteen minutes to twenty minutes per pupil. Certain adaptations in the methods of presentation, particularly in the Kinaesthetic Method, were necessary because of the limited exposure of grade one entrants to reading and writing. The adaptations in the methods will be noted as each method is discussed later in the chapter.

II. THE TEST POPULATION

The grade one entrants tested in this experiment were pupils of a public school in the city of Saskatoon. Eighty-two pupils were registered as beginners at the commencement of the school term in September, 1963. Four children who moved from the district and three children who were absent from school on testing days were subtracted from the original sample thus reducing the testing sample

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to seventy-five pupils with thirty-six boys and thirty-nine girls. No child repeating grade one was included in the testing program nor was any child who had moved into the district subsequent to the beginning of the school term. In order that visual and hearing efficiency might be controlled it was necessary to limit the sample to those children whose hearing and vision fell within the normal range as measured by the screening tests. A total of two boys and four girls and three boys and four girls failed to pass the visual and auditory screening tests respectively. The final sample therefore consisted of sixty-two children with equal numbers of each sex.

Table I shows that the test population ranged in chronological age from 5 years 10 months to 6 years 8 months with a mean of 6 years 3 months. Chronological ages of the boys ranged from 5 years 10 months to 6 years 7 months with a mean of 6 years 3 months while those of the girls ranged from 5 years 11 months to 6 years 8 months with a mean chronological age of 6 years 4 months. The mental age of the group ranged from 5 years 4 months to 10 years 4 months with a mean mental age of 7 years 1 month. The girls ranging in mental age from 6 years 1 month to 9 years, had a mean mental age of 7 years 2 months. The range in mental ages of the boys was from 5 years 4 months to 10 years 4 months with a mean of 6 years 11 months.

TABLE I

COMPARISON OF CHRONOLOGICAL AGES, MENTAL AGES, AND INTELLIGENCE QUOTIENTS

Number of Pupils Boys: 31 Girls: 31 Total: 62

	Range	Mean	Standard Deviation	Comparison of Means for Boys and Girls: Observed Differences	Standard Error of Differences	Critical Ratio
	A	B	C	D	E	F
1. Chronological Age						
Total	70-80 months	75.6	2.3			
Boys	70-79 months	74.7	2.3	1.7	.58	±2.93*
Girls	71-80 months	76.4	2.3			
2. Pintner-Cunningham Primary Mental Age						
Total	64-124 months	84.6	10.4			
Boys	64-124 months	82.9	12.4	3.3	2.64	±1.25
Girls	73-108 months	86.2	7.8			
3. Pintner-Cunningham Primary Intelligence Quotient						
Total	84-148 months	110.7	11.1			
Boys	84-148 months	109.8	12.6	1.9	2.83	±.67
Girls	91-131 months	111.7	9.5			

*Significant at .05 level of confidence

Intelligence quotients of the total sample as measured by the Pintner-Cunningham Primary Test ranged from 84 to 148 with a mean intelligence quotient of 110.

This school draws its pupils largely from families in a relatively new housing area. Approximately fifteen per cent of the original sample and ten per cent of the final sample came from a low-cost housing area. An examination of the Family Record Cards for the test population showed the average family size to be three children. The same source indicated that twenty-five per cent of the sample were the eldest siblings in their family while twenty-two per cent were the youngest siblings. These figures were altered in the final sample to twenty-seven per cent and twenty-two per cent respectively. Registration records indicated that about sixty per cent of the children had attended kindergarten. However, some of these were church-sponsored and others privately-sponsored with no central authority to supervise their administration or curricula so that the effect of the kindergarten variable could not be systematically investigated. The school itself opened seven years ago with eight classrooms in operation but it has recently been enlarged to include nineteen classrooms.

At school commencement the children were assigned to one of three single-grade classrooms, all with

experienced teachers in charge. The average enrolment in these classrooms was twenty-eight pupils. Children were assigned to one of the three classrooms according to whether their birthdays fell in the first, second, or third group of four consecutive calendar months. The exception to this was that two sets of twins were divided. Repeaters were assigned in equal numbers to the classrooms containing the two oldest groups. As indicated later under the description of the testing instruments, the children followed the regular classroom routine except during those periods when they were in the teaching-testing program of the Learning Methods Test for five consecutive, daily periods of twenty minutes duration.

Reading instruction in these three classrooms follows the pattern of instruction in other Saskatoon Public Schools. The materials of the Curriculum Foundation Series (1959) form the basis of instruction and are supplemented by those of the Ginn Basic Reader Series (1957) and the Brett-Macmillan Series (1957). Other well known series are available to the teachers for supplemental or extension purposes. The three above-named series emphasize development of word attack by the use of meaning, picture, and word-form clues and phonetic and structural analysis. General procedures, outlined in the guidebooks of the basic reader series, are followed by

the teachers. In addition, a Phonics Manual (unpublished), compiled and written by the Supervisor of English for Saskatoon Public Schools, outlines and emphasizes the phonics introduced in the basic reader series. While recognizing that phonetic analysis is only one method of word attack, this Phonics Manual stresses the introduction of the phonic skills at a much earlier level than that advocated by the manuals of the basic reader series mentioned. This is particularly so in the first grade. As soon as the child enters school he will be given instruction in the comparison of similarities and differences, in noting initial sounds, and in recognizing rhymes. During the pre-primer period the child is introduced to the five initial consonants--f, s, m, c, and b and both names and sounds of these letters are taught. At the primer level all other consonants are taught, initial and final consonants are noted, and the digraphs sh, ch, th, and wh are introduced. At the first reader level the five vowels are taught with their short and long sounds (the long sound elicited by final e and in vowel digraphs). The alphabetical order of the letters is also taught at this level.

Although sight words were being taught in the classrooms right from the beginning of the testing period this seemed to have very little effect on the children's recog-

nition of the words on the picture-word cards used in the *Learning Methods Test*. The latter were all common nouns while the words taught in the classrooms in this period of beginning reading, were, for the most part, verbs, proper nouns, simple adjectives, and some pronouns.

As in other schools within the system the Continuous Progress Policy is followed in this school. In effect, however, these first months at school are largely ones of identification of the child's strengths and weaknesses and grouping is very flexible. During the period when this experimental study was in progress the effect of the Continuous Progress Policy, as such, would be difficult to distinguish from that of other grouping plans in most grade one classrooms over the same period.

III. THE TESTING INSTRUMENTS

The tests described in this chapter were used to measure intelligence, reading aptitude, and methods of word recognition. Screening tests used to determine auditory and visual defects are also described.

Intelligence Tests

Pintner-Cunningham Primary Test (Form C). It was not practical in terms of time and available personnel to administer individual tests of intelligence so the group

test used in all grade one classrooms of Saskatoon Public Schools was used as the measure of intelligence. This test, the Pintner-Cunningham Primary (Form C), contains seven different subtests covering as many different aspects of general mental ability. It is composed entirely of pictures which are marked by the pupils according to the verbal directions given by the examiner. The subtests are listed and described briefly below:

A. Test 1. Common Observation.

On this test the child must draw a straight line under all of the pictures which have something in common, such as all of the things which Father uses when he builds a house, all of the things that have fur, or all of the things that walk on the ground.

B. Test 2. Aesthetic Differences.

The children must judge and mark which are the "prettiest" pictures in a group of three pictures.

C. Test 3. Associated Objects.

The child is required to put a mark on the pictured object which belongs with the first pictured object in each row.

D. Test 4. Discrimination of Size.

This test requires the child to mark the

pictured object which, because of its size, he judges to be "just right" to go with the first picture in each row.

E. Test 5. Picture Parts.

This test requires the child to mark the picture part outside of a framed picture which matches an identical part within a framed picture.

F. Test 6. Picture Completion.

This test requires the child to find among a group of pictured parts the one which will complete the main figure.

G. Test 7. Dot Drawing.

By using a second group of dots provided for him the child must reproduce the dot-drawing model.

As evidence of the validity, the authors--Pintner, Cunningham, and Durost (1946)--quoted the study of Dougherty and the two studies of Pintner in which this test was correlated with the Stanford-Binet and showed coefficients of correlation to be .80, .73, and .88 respectively. To support claims of reliability they quoted coefficients of correlation between Form A (Revised) and other forms of the test at three different grade levels. These coefficients ranged from .83 to .94.

Bellows, as quoted in Buros (1940, p. 238) notes that there is high statistical validity reported for the Pintner-Cunningham Primary Test and that "reliabilities for the total tests are high enough for group comparison but test performance must of course be interpreted with great caution when the purpose is individual diagnosis or orientation." Bellows comments also on the care used in the development of this test, the elaborate standardization procedures, and the detailed evaluation before publication.

The Pintner-Cunningham Primary Test was administered at the end of the first month of the school term. A copy of the test is contained in Appendix B.

Tests of Reading Aptitude

The Monroe Reading Aptitude Tests (Primary Form). The purpose of administering the Monroe Reading Aptitude Tests was to determine how closely the children's performance in the perceptual skills measured by these tests would be related to their performances on the Mills Learning Methods Test and to the other measures of visual, auditory, and motor skill or to combined measures of these skills. The Monroe battery measures aptitude in five major areas--visual, auditory, motor, articulation, and language. With the exception of the Articulation Test which contains only

two subtests, there are three subtests in each area. In addition to the above, a test of hand, eye, and foot preference is included. The aptitude tests, consisting of group and individual subtests, were administered at the end of the first month of school. Group tests were given to groups of ten or twelve subjects at one sitting of from thirty to forty minutes duration and they included:

A. Visual Test 1. Memory of Orientation of Forms.
The child is required to circle in his booklet the geometric form which matches the one shown him on large cards by the examiner. Reversed single forms and reversed arrangements of several forms in a group are characteristic of these drawings.

B. Visual Test 2. Ocular-Motor Control and Attention.
Co-ordination of eye-hand movements is measured as with his finger the child follows a continuous line along an increasingly complex route to the destination point which he circles in pencil.

C. Visual Test 3. Form Memory.
After a ten-second exposure the child is required to reproduce as many as he can recall of the four geometric designs on each of the four large cards shown to him by the examiner.

two elementary (there are [illegible] included) in each group. [illegible] admitted to the school, [illegible] [illegible] is included). The [illegible] group and [illegible] [illegible] end of the first year of school. [illegible] in groups of ten or twelve [illegible] from twenty to thirty [illegible]

4. [illegible]

5. [illegible]

6. [illegible]

This test should indicate if the child is subject to confusion by complex patterns, weak or inaccurate visual memory, reversals, and transpositions.

D. Auditory Test 1. Word Discrimination and Orientation.

The ability to discriminate correct pronunciations of words and the ability to recall sequences are both measured by this auditory test as the child associates the word pronounced with the picture and the first, second, or third number which corresponds to the order in which the correct word was pronounced.

E. Auditory Test 2. Sound Blending.

This test measures accuracy in sound discrimination as well as sound blending, both of which contribute to the ability to use phonetic attack in word-building. After the examiner has given him the sounds unblended the child is required to circle the picture corresponding to the word which is the product of his sound blending.

F. Motor Test 1. Motor Speed.

Speed of reaction and muscular co-ordination

are measured as the child, within a sixty-second time limit, is required to make a little dot inside of as many as possible of the one hundred small circles, each of which measures approximately one sixteenth of an inch in diameter.

G. Motor Test 2. Motor Steadiness.

This untimed test measures the child's ability to stay on a line, as he is required to draw one unbroken line following the dots and dashes given in the booklet.

H. Language Test 1. Vocabulary.

Listening vocabulary is measured by the child's ability to circle the drawing in each group which corresponds to the word spoken by the examiner.

The subtests given to each subject individually included:

A. Auditory Test 3. Auditory Memory.

The child's auditory memory is measured by the number of facts he can recall from a story read to him by the examiner.

B. Motor Test 3. Writing Name.

By requiring the child to write his name, this test gives a measure of motor control

guided by visual memory to reproduce a complex pattern. A five point graduated scale is used to obtain a score.

C. Articulation Test 1. Reproduction.

The child is measured by his ability to reproduce clearly and accurately the words spoken to him by the examiner. These words become increasingly longer and more difficult.

D. Articulation Test 2. Speed.

Speed of articulation is measured by the number of times the child can repeat the given phrases within a fifteen-second time limit.

E. Language Test 2. Classification.

Vocabulary and facility in verbal ideation are involved in this test. Within each thirty-second time limit the child is required to name as many as he can recall of one of the following three groups: (1) animals, (2) things to eat, and (3) toys.

F. Language Test 3. Sentence-Length.

The number of words in his longest sentence used to describe a picture is the child's score obtained in this measure of language

development. Monroe (1935) noted that it is possible that children who use long complex sentences will have less difficulty in learning to read and in interpreting the meaning of the text than those who use short, simple, or fragmentary sentences.

Wepman Auditory Discrimination Test (Form A). Research into readiness for reading and success in beginning reading has given ample evidence to support the significant role played by auditory discrimination. The Wepman Auditory Discrimination Test was administered to these grade one entrants in order to determine how closely success in auditory discrimination is related to success in other auditory skills and in learning to recognize words by methods that stress visual, auditory, motor, or combined perceptual skills. This test measures the child's ability to discriminate auditorily between words that differ by only a single phoneme. In the test sixty-four paired words, either similar or identical in sound, are presented orally to the child who is seated with his back to the examiner. The complete test consists of paired comparisons of 11 initial consonants, 19 final consonants, 11 medial vowels, 1 open syllable or final vowel, and 22 false-choice pairs. The false-choice pairs are used as a check against patterned

responses or lack of attention to the task. The child is required to indicate whether he hears the words as the same or different and he may respond by any way he chooses --by a nod of the head or a word. The number of correct responses to the pairs presented was taken as the score. The test was administered to all the sample during the sixth week of school.

Visual Discrimination Tests. The _Visual Discrimination Tests_ (unpublished) were administered in order to determine how closely the children's performances on these tests would be related to other measures of visual perceptual skill and to the four methods of the _Learning Methods Test_, particularly to the Visual Method. This group test was designed by Maisie Wheatley, a primary specialist of the Edmonton Public School Staff, under the supervision of Marion D. Jenkinson of the Faculty of Education, University of Alberta in Edmonton. The test has been used in three independent exploratory studies and when a sufficiently large sample has been obtained it is hoped that it may be revised and later standardized. Three independent markers were employed to establish the criteria for scoring. The test, designed to be given to an entire class, was administered to the subjects of the present sample in two sittings for each class. The first part of

responses to [illegible]
resulted in [illegible]
case of [illegible]
[illegible]
responses to [illegible]
The [illegible]
sixth week of [illegible]

[illegible]
within [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
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[illegible]
[illegible]
[illegible]
[illegible]

the tests consists of six subtests of visual form discrimination. These subtests include:

A. Test 1. Delayed Visual Association.

The child is required to associate the pictures of seven common animals with simple geometric forms or configurations and is measured by the number of these that he can recall twenty-four hours later.

B. Test 2. Matching Rotated Forms.

The child chooses and circles one of the five simple forms which is identical to the first picture on each line. Most of the forms are rotated either partially or completely.

C. Test 3. Matching Rotated and Reversed Forms.

This is similar to Test 3 but a choice must be made from both rotated and reversed forms.

D. Test 4. Immediate Visual Memory.

Immediate recall of word-like configurations is measured by the number of correct configurations circled to match those given on each of the nine large cards exposed by the examiner for ten seconds.

E. Test 5. Pattern Copying.

The child is required to draw the best reproduction he can of the eleven models given.

These models consist of eleven simple geometric forms, with or without internal and external detail and include circles, rectangles, squares, diamonds, and triangles. The drawings are scored on the basis of size, placement, external detail, and internal detail.

F. Test 6. Pattern Completion.

This test of eleven items is similar to Test 7 except that a partially completed pattern is provided and the child must add to it to make it identical to the model. Scoring is on the same basis as the previous test with the omission of the placement criteria.

The second part of the tests consists of six subtests of <u>letter</u> or <u>word</u> discrimination. The subtests included are:

A. Test 1. Simple Letter Matching.

The child must discriminate between letters similar in configuration by circling one of the correct choices which is identical to the letter given at the first of the line.

B. Test 2. Letter Matching.

This is similar to Test 1 but made more difficult by the inclusion of letter reversals.

C. Test 3. Word Matching A.

The child must choose, from a group of three words (of similar configuration), the word that is identical to the first word given.

D. Test 4. Word Matching B.

This is similar to Test 3 but since all the choices in a group contain identical final consonants he must discriminate correctly among initial consonants.

E. Test 5. Word Matching C.

This is similar to the two previous tests but here discrimination of medial vowels is tested.

F. Test 6. Word Matching D.

Discrimination of words of similar configuration including word reversals is tested.

A score on each of these subtests is obtained by counting the number of correct responses.

<u>Methods of Word Recognition</u>

<u>The Learning Methods Test</u>. The major instrument used in this study was the <u>Learning Methods Test</u>. This instrument, designed by Mills (1955) at the University of Florida, measures the child's proficiency in the task of learning to recognize words under various teaching proce-

dures. Mills noted that in order to obtain content validity the test items (that is the picture word cards) were selected from frequency studies of word usage from 104 representative school systems throughout the United States (1945). He further noted that its usability in clinical situations has been demonstrated in more than one hundred clinics. The present study appears to be the only one in Canada making use of this instrument in a non-clinical situation and with children younger than seven years old. A member of the staff of the Greater Winnipeg Child Guidance Clinic has used the instrument in a project in preparation for a doctoral dissertation at the University of Chicago but, as yet, no interim report of this study is available. The children in the latter study, in contrast to the grade one entrants of the present study, have undoubtedly been exposed to at least one year of reading instruction and probably a good deal more than one year.

Test materials. Test materials include the picture-word cards devised for use with the Learning Methods Test, test record forms, and a manual of directions which contains specific directions for the four teaching lessons, each of which stresses a different method (visual, auditory, kinaesthetic, or a combination of the previous three). The picture-word cards include

46 primer, 120 first grade, 114 second grade, and 130 third grade level words selected from the _Author's Word List for the Primary Grades_ by Krantz (1945). This list was drawn from a compilation of frequencies of word use in 84 pre-primers, 69 primers, 84 first grade readers, 85 second grade readers, and 104 third grade readers. The words chosen were all nouns so that there would be little chance of ambiguity in the pictures representing them.

The order of administration of the Learning Methods Test. In order to minimize sequence effects, the order in which each method would be taught to each child had been determined by randomizing the possible sequences independently for each subject. The twenty-four possible sequences (four factorial) of teaching the four methods (Visual, Auditory, Kinaesthetic, and Combination) were written on slips of paper, placed in a box, mixed thoroughly, subsequently drawn out by a teacher in the school, and recorded in the order of withdrawal beside the children's names as they appeared on the class list. The slips remaining in the box were then discarded. This procedure was repeated for each of the three classes so that each of the possible sequences had three chances of being drawn. It was assumed that any subsequent withdrawal

of pupils from the total sample, due to such factors as illness, or visual and auditory defects, would be randomly distributed among the classes, sexes, and other classification groups. Once the sequence of teaching the methods had been selected for each child his record form was prepared. Included on the form were spaces for the child's name, sex, grade, chronological age, intelligence quotient, the level of word cards used, and his score on immediate and delayed recall of words learned by each method. The selected sequence of teaching methods was recorded on the form prior to the pre-test of word recognition. A sample copy of the record form appears in Appendix A.

Selection of test items. To select the test items a pre-test of word recognition was given. The primer level picture-word cards of the Learning Methods Test were presented word-side up. If at the end of five seconds of exposure the child did not respond correctly he was told the word and shown the next card. The unknown words were placed in a separate pile. From the unknown words forty words were selected at random (by shuffling the stack thoroughly and then counting off the first forty cards). These words were recorded in four sets of ten words on the test record form for each child and became the training and test items for each of the four methods.

In order that forty words of equal difficulty might be used for the four methods, all words were chosen from one level. Thus, if there were not forty unknown words at primer level the child was pre-tested with first grade words. However, in this study all the children were trained and tested on primer level words except for eight children with whom it was necessary to use first grade level words.

The training periods. The pre-test of word recognition was followed by the first training period. As noted at the beginning of this chapter the pilot study had revealed the necessity of increasing the length of the training periods from fifteen to twenty minutes for grade one entrants. At the end of the training period a test of immediate recall was administered using the same time limits as on the pre-test. The test of delayed recall was administered prior to the second day's training period exactly twenty-four hours later. Thus the pattern was set for the five consecutive days required to train and test each child. In summary then, the administration of the test was as follows:

First Day
  Pre-test of word recognition
  Teach 10 words by Method I
  Test of immediate recall

Second Day
  Test of delayed recall for Method I
  Teach 10 words by Method II
  Test of immediate recall

Third Day
  Test of delayed recall for Method II
  Teach 10 words by Method III
  Test of immediate recall

Fourth Day
  Test of delayed recall for Method III
  Teach 10 words by Method IV
  Test of immediate recall

Fifth Day
  Test of delayed recall for Method IV

The four methods used in the training sessions were the Visual, the Auditory (or Phonic), the Kinaesthetic, and the Combination Methods. Each method involves specific steps or techniques which were used in the same order for each subject. However, since the test was used with younger and less experienced children than it had been used with in previous studies, certain adaptations had to be made in the presentation of these methods. The adaptations made by the present investigator are noted in the description of each method.

The Visual Method. Using ten unknown words from the list recorded under the heading of the Visual Method the child was taught to recognize the words by stressing their visual appearance and other visual clues. The steps followed in the twenty-minute period were as follows:

A. Step 1. The ten picture word cards were presented picture side up. The child was asked to examine the picture first, then the

word, and finally to identify the word by its picture. This was done with all of the ten word cards.

B. Step 2. With the cards presented picture-side up a second time the child was asked to make a sentence using the word. Help was given if necessary.

<u>Adaptation</u>: The child was asked to repeat all of the words.

C. Step 3. A game of solitaire was played. All cards were laid picture-side down before the child. As he said each word he checked his accuracy by turning to the picture-side.

<u>Adaptation</u>: If the child failed to identify all of the words, the examiner called out the ones that were missed, and as each was called the child pointed to a card and again checked his accuracy by turning over to the picture side.

D. Step 4. The child was asked to use as many words as he wished in a meaningful sequence to form a sensible phrase or sentence. He was allowed to add extra words to make a complete sentence.

E. Step 5. The relative length of words was dis-

cussed. The child matched words of the same length and placed them in separate rows.
<u>Adaptation</u>: Because many of the children could not visually separate the letters one from another and many had difficulty in counting, the examiner assisted them by pointing or blocking out one letter from the other and counting with them.

F. Step 6. The configurations of the words were drawn on the board one at a time and the child was asked to match these with the words arranged in rows--those rows remaining from the fifth step. Four aspects of the configurations were drawn to the child's attention: (1) the number of letters indicated by the number of boxes, (2) the "tall letters standing above the line," (3) the "small" letters, (4) the "tall letters that stood partly below the line." The base line of the printing, from which the letters originated, was always indicated by the examiner tracing it with the finger before the child began his scrutiny of the configuration.

<u>The Auditory or Phonic Method</u>. Using the ten unknown

words listed on the record sheet under the heading of the Auditory Method, the child was taught for a period of twenty minutes in which the sound qualities of the words were stressed.

A. Step 1. a) Each word in turn was printed on the blackboard, said slowly in syllables by the examiner, and repeated by the child.
Adaptation: The child repeated the word and tapped out the "beats" or syllables following the pattern set by the teacher.
b) To ensure that he knew the meaning of the word the child was asked to make a sentence with it. The words were repeated by the examiner as she pointed out the sound elements, named them and gave them their sound, after which the child repeated these sound elements and then blended them into a whole word.

B. Step 2. The child was asked to think of and name other words beginning with and ending with the same sound as the words being taught. (The ending sounds proved very difficult for children at this level.) The words were arranged in groups having the same beginning or ending sound.
Adaptation: Each time the card was handled

the word was repeated--with help, if necessary.

C. Step 3. The examiner helped the child to think of rhyming words for the words being taught.

D. Step 4. The child was helped to identify familiar sounds or little-words-in-big-words of those being studied.

E. Step 5. All ten words were repeated with exaggerated sound stresses and short pauses between the sound elements. The child listened closely to the words as they were pointed out by the examiner and then he repeated the word.

F. Step 6. The child was asked to repeat all the words while the examiner pointed out the letters symbolizing the sound elements.

<u>The Kinaesthetic Method</u>. Since the children had done little or no writing of any kind, particularly in the first portion of the testing period, the Kinaesthetic Method required more adaptations. Both the order of the steps and the actual steps themselves were revised. The method as outlined in the manual involved using all the following steps with each word before proceeding to the next word: (1) tracing the word on the blackboard or paper with the finger as each word was said part by part, (2) repeating

the tracing several times, (3) writing out the word as it was said, (4) repeating the tracing and writing until the word could be reproduced in writing by the child, (5) repeating steps one to four with all words, and (6) repeating step one with all of the words. The pilot study revealed that even writing one word while looking at the copy absorbed the portion of time allotted to one step for the child. The following steps were therefore adapted for use with these children:

A. Step 1. The examiner wrote each word in large manuscript writing on chalkboard and said the word slowly in parts. The child repeated the word and then traced it with his jumbo-sized chalk as he said it. (His tracing was so much slower than his sounds that, of his own volition, he kept repeating the word until he had finished writing it. The word on the chalkboard was then compared to the one on the card.) This step was completed with all of the words.

B. Step 2. The child then traced over the word with the edge of the blackboard eraser and repeated the word as he traced. The combination of the imprint made by the jumbo-sized primary chalk and the outline left by the

eraser left a very pronounced "shadow" of the word remaining on the chalkboard. (Note: Steps 3, 4, and 5 were completed with <u>each</u> word in turn before going on to the next word.)

C. Step 3. Words two inches in height were printed with jumbo-sized wax crayon on paper. The child said the word as he traced it with his finger.

D. Step 4. After tracing each word the child was asked to examine it visually, place his finger on the first letter, close his eyes, and retrace the word as he said it. He was permitted to open his eyes if his memory failed him before he completed the word but if this was necessary he repeated the step.

E. Step 5. The words traced were compared to the card-sized words and repeated orally. Time limits did not permit retracing at this point.

<u>The Combination Method</u>. The other methods were combined into an eclectic method giving approximately equal stress to the visual, auditory, and kinaesthetic elements. The ten unknown words recorded under the heading of the Combination Method were taught in the following steps:

A. Step 1. The ten picture-word cards were presented to the child with the picture side up. The child looked at the picture, then at the word and said the word. The word was repeated by the child several times as he re-examined both word and picture.

B. Step 2. The initial letter sounds of the words were presented as they were pointed out in each word. At this time also the child was helped to think of rhyming words or other words that began or ended like these words. Adaptation: The beats or syllables of the words were also tapped out by the examiner as she pointed to the words and the child repeated the pattern and word-parts.

After the ten words had been taught in this manner they were reviewed by the examiner repeating them slowly in exaggerated sound stresses while pointing out the sound elements. The child repeated this review of each word after the examiner.

C. Step 3. The word was written with wax crayon on paper (in the same manner as in Step 3 of the Kinaesthetic Method) and the child traced over the words with his fingers as he said

the word. (Because of their lack of experience with sound symbol association or writing, most of the children were unable to say the words in parts after the model of the teacher.)

D. Step 4. With eyes closed the child was asked to trace the word (as in the same adapted step of the Kinaesthetic Method) and then with eyes open he repeated the word in exaggerated sound stresses after the teacher.

E. Step 5. The fifth step in the manual requires that Step 4 be repeated.

<u>Adaptation</u>: The child was asked to first play a game of solitaire with the cards and then to identify and repeat the words called out by the examiner.

<u>Test reliability</u>. Mills (1955) determined the reliability of the test by retesting thirty subjects using the "equivalence of forms" technique. Reliability coefficients were obtained on all four methods by correlating the number of right responses for a particular method on Form A with the number of right responses (delayed recall) for the same method on Form B. These coefficients for the Visual, Auditory, Kinaesthetic and Combination Methods were .969, .970, .908, and .954 respectively.

Auditory Screening Test

Maico Individual Audiometer Test. The individual audiometric screening tests were given to the children in the testing population by the hearing therapist for Saskatoon Public Schools who administers these tests to all first-grade pupils. The testing instrument, the Maico Audiometer, is a portable unit equipped with earphones. The child is seated so that he is unable to see the panel of the audiometer which is operated by the examiner. The hearing loss dial regulates the intensity of each test tone. These test tones are graduated in five decibel steps from slightly above normal to maximum loudness. The amount of hearing loss for low, medium, or high pitches is tested by checking each test tone of intensity at the frequencies noted at the top of the panel. These frequencies range from 125 to 8,000 cycles. After careful instruction, the earphones are comfortably placed on the child's ears and a test tone of moderate loudness and pitch (usually about 30 decibels at 1,000 cycles) is used to illustrate to the child the idea of the sound for which he must listen. The child indicates that he has heard the tone by saying "yes." Since a hearing loss of up to 10 decibels is considered normal, the child's hearing on each ear is screened at fifteen decibels. If any hearing loss is indicated at this tone the audiogram is completed in order to check

whether the failure to pass the screening test at fifteen decibels is due to inattentiveness, failure to understand instruction, or to a true hearing loss. Thus children who failed to pass the screening test were referred to a medical doctor. Results for each ear were indicated graphically on one side of the audiogram card and brief biographical and identification data were recorded on the other side.

Visual Screening Test

In administering the screening test of visual efficiency the present investigator was assisted by a local optometrist who has had experience in designing and conducting visual surveys of elementary school children. The items on the screening test were selected according to the frequency with which they are mentioned in the literature pertaining to school visual surveys. With the exception of color perception, they included those items screened by such popular devices as the Keystone Telebinocular and the Bausch and Lomb Ortho-Rater.

The tests, described briefly below, were given by the present investigator aided by a simple stereoscope and appropriate stereoscopic slides supplied by the Keystone View Company.

<u>Tests of Fusion</u>. For normal binocular vision both eyes must be focussed accurately on the same target to allow a fusion in the brain of the slightly different images from the two eyes. Thus, if in examining the stereoscopic slides, the child sees more than one image (in this case black lines or blocks) the eyes are not achieving a fused single image. This could lead to considerable confusion in visual discrimination, especially when the symbols are unfamiliar as in learning to read.

<u>Tests of Suppression</u>. When there is a failure to achieve fusion the person may see a double image but more commonly the image from one eye is ignored or suppressed. The test which measured this aspect of visual efficiency presented to the child three diagrams of a jack-o-lantern, one complete, one with the right ear missing, and one with the left ear missing. If the visual images from both eyes are fused into a single image the subject will see the completed diagram, but if one eye is being suppressed he will see the image with the opposite ear of the jack-o-lantern missing.

<u>Tests of Eye-Muscle Balance</u>. Proper fusion may also be associated with the degree of balance achieved among the six pairs of muscles which turn the eyeballs. Problems arising when muscles pull or tend to pull an eye

to one side or another are referred to as lateral imbalances. Those problems that arise when the muscles pull or tend to pull an eye up or down are referred to as vertical imbalances. Lateral imbalances were detected in these tests by the position of the last symbol the child could identify in a horizontal, left-to-right arrangement. In the tests of vertical phoria the child was required to note where the green horizontal line was in relation to the red ball. If the child noted that the green line passed through the red ball he was considered to have passed the test.

Test of Stereopsis. Stereopsis or depth of visual perception is related to the ability of the eyes to achieve a fused image. On this test the child put on a pair of stereoptic eye glasses through which he viewed a diagram of the common housefly. To the normal eye the housefly appeared three-dimensional through these glasses and when the child was asked to "touch the wings of the fly" he would normally under-reach the wings on the diagram by four to six inches. If in reaching he actually touched the diagram, he was considered to have failed the test.

All of the foregoing visual efficiency tests were tested at both near-point and far-point range.

Test of Near-point Acuity. The test of near-point acuity measures the child's binocular vision at reading

distance by requiring him to distinguish symbols gradually decreasing in size.

Test of Far-point Acuity. Far-point acuity was measured by the child's ability to distinguish the letters in correct position on the 20/40 line of the familiar E Chart (published by the American Optical Company). In order that no confusion would arise due to lack of familiarity with the symbol E, the child was required to manipulate a large cardboard E to a position matching that of the one on the chart indicated by the examiner. Failure to distinguish the correct position of two or more of these was considered a failure on the test. The passing level on this test may seem to be a generous one but was considered sufficiently discriminating for the purposes of this study. Far-point acuity would have little effect on performance in the individual tests and even in the group tests this measure would be sufficient to detect any weaknesses affecting performance.

The optometrist, using an opthalmoscope, a pen flashlight, and a cover test, checked for (1) phoria, (2) tropia, (3) fusion recovery, and (4) near-point convergence. Brief descriptions of what was measured in each of these tests are given below:

Tests of Phoria. The tests of phoria measure

tendencies toward eye-muscle imbalance.

Tests of Tropia. The specific muscular imbalances are detected by the tests of tropia. Thus a lateral imbalance in which an eye turns in is referred to as *esotropia* and the one in which the eye turns out is referred to as *exotropia*. (The corresponding terms noted under the tendencies of phoria would be *esophoria* and *exophoria* respectively.)

Test of Near-point Convergence. This test measures the ability to maintain singleness of vision for prolonged periods at near-point. (The subject should be able to maintain fixation with both eyes as the light of the flashlight is brought to within two inches of the nose.)

Test of Fusion Recovery. The test of fusion recovery measures the efficiency of the pupillary muscles in adjusting the pupil size according to the amount of illumination.

A copy of the form used to record the findings in the Visual Screening Test may be found in Appendix D.

IV. TEST PROCEDURES

All of the group tests were administered by the present investigator with the exception of the *Pintner-*

Cunningham Primary Test which was administered by the school principal who is an experienced administrator of this test. The individual audiometric screening tests were given by the hearing therapist for the Saskatoon Public Schools. A local optometrist, experienced in conducting visual surveys for schools, assisted with the visual screening test. All other individual tests were administered by the present investigator.

V. TREATMENT OF DATA

Only those children who completed all tests and whose hearing and vision fell within the normal range were retained in the sample.

The information obtained from the test results and other data were processed at the Computing Centre at the University of Alberta, Edmonton. A program was set up which resulted in correlations with sixty-two variables. Intercorrelations, means, standard deviations, and variances were obtained for the total sample and for boys and girls separately. The differences between means for boys and girls were calculated and then tested for statistical significance. Where preceding tests for homogeneity of variance had demonstrated that the assumptions underlying the conventional "t" test were untenable, the method of Cochrane and Cox, as reported in Ferguson (1959, p. 143)

was used to perform an alternate "t" test.

Further analysis of the data took the form of four factorial experiments, designed to evaluate the single and combined effect of the various levels of the treatment variables (the four teaching methods of the <u>Learning Methods Test</u>) and certain levels of four classification variables (sex, mental age, chronological age, and the particular class to which the child had been assigned). In each experiment the criterion or dependent variable was the Delayed Recall score for each treatment or method. The Delayed Recall score was selected in preference to the Immediate Recall score because it appeared to be the more stable measure of word recognition. The total sample (N=62) was involved in each of these experiments.

Because the same subjects had been observed under each of the four treatment variables in order to compare rates of learning in these experiments, a repeated measures design was necessary. The designs were patterned after the models proposed by Winer (1962) for multifactor experiments having repeated measures. In order to minimize sequence effects, the order of administration of the methods (Visual, Auditory, Kinaesthetic, and Combination) was randomized independently for each subject. The randomization procedures have already been described fully in this chapter under the paragraph sidehead <u>Order of</u>

administration of the Learning Methods Test which is contained within the third division entitled TESTING INSTRUMENTS.

A brief description of each factorial design is given.

Sex versus Methods--Analysis of Variance I (N=62)

This was designed as a two-by-four factorial experiment with two levels of factor A (Sex)--male and female, and four levels of factor B (Methods)--Visual, Auditory, Kinaesthetic, and Combination. Since there were equal numbers of each sex, the analysis followed the model for a two-factor experiment with repeated measures and equal cell frequencies, given by Winer (1962, p. 307).

Mental Age versus Methods--Analysis of Variance II (N=62)

This analysis took the form of a three-by-four factorial experiment with the same four treatment variables as the one given above and three levels of mental age--High, Middle, and Low groups. These levels of factor A (Mental Age) were determined by computing the upper and lower quartiles and the interquartile range of the distribution of mental ages. Thus the groups ranged in mental age as follows: High (above P_{75}, N=16) from 89 to 124 months, Middle (P_{75} -P_{25}, N=30) from 79 to 88 months, and Low (below P_{25}, N=16) from 64 to 78 months. Because of

the unequal cell frequencies, the Analysis of Variance was modelled after that of Winer (1962, p. 375)--a least squares solution for a repeated measures design and adjusted to fit a two-way model.

An experiment which was identical in design to Analysis of Variance II, except for the classification variable, was used as a check to determine whether the four levels of the treatment variable (the methods) would obtain any significantly different effects when three levels of intelligence quotient were substituted for the three levels of mental age. The three levels of intelligence quotient--High, Middle, and Low groups were determined by computing the upper and lower quartiles and the inter-quartile range of the distribution for the total sample. Thus the groups ranged as follows: High (above P_{75}, N=15) from 116 to 148, Middle (P_{75} - P_{25}, N=30) from 105 to 115, and Low (below P_{25}, N=17) from 84 to 104.

Chronological Age versus Methods--Analysis of Variance III (N=62)

This analysis took the same form and employed the same method of solution as those described for Mental Age versus Methods. The treatment variables and dependent variables were identical to those in the above experiments. The classification variables--the three groupings of

Chronological Age, were set up in the same manner as the Mental Age and Intelligence Quotient groupings. Group I (above P_{75}, N=25) was composed of the oldest children whose ages ranged from 78 to 80 months. Group II (P_{75} - P_{25}, N=25) included those children whose chronological ages ranged from 75 to 77 months. Group III (below P_{25}, N=14) was made up of the children whose ages ranged from 70 to 74 months.

Classes versus Methods--Analysis of Variance IV (N=62)

As noted earlier in the chapter, the children had been assigned to the three classes according to their chronological ages. For the Learning Methods Test the older children were taught first and the younger children last. Because this experiment carried over ten weeks the effect of this was to reduce the chronological age range since the ages for the purposes of this analysis are those recorded at the time of administration of the Learning Methods Test. In an effort to determine whether the extra school experience had affected their performance on this test the results were analyzed according to classes. The analysis took the form of those given above for repeated measures with unequal cell frequencies. The classes were as follows: Class I, the oldest children (N=22), Class II, those in the middle chronological age range (N=20),

and Class III, the youngest children (N=20).

The data with regard to the comparative chronological ages, mental ages, and intelligence quotients of Classes I, II, and III are presented in Table II. The comparison of mean chronological ages revealed that the classes differed significantly on this variable. Since the children had been allocated to the classes according to three chronological age groupings, it is not surprising to note that the classes differed from one another with a difference that was statistically significant at well beyond the .01 level of confidence. The comparisons of means for mental age and intelligence quotient demonstrated clearly that there was a much greater range of mental ability in Class II than in either of the other two classes. However, the only difference that reached an accepted level of statistical significance is that which favored Class II when it was compared to Class III in mean mental age. The observed difference of 4.7 obtained a critical ratio of $\pm$ 3.31 which was significant beyond the .01 level of confidence. This will be taken into account in the interpretation of the findings.

VI. SUMMARY STATEMENT

The research design of the ten-week experimental study conducted with grade one entrants in a Saskatoon

TABLE II

COMPARISON OF CHRONOLOGICAL AGES, MENTAL AGES, AND INTELLIGENCE QUOTIENTS

OF THE THREE CLASSES

Number of Pupils -- 62 Class I -- 22 Class II -- 20 Class III -- 20

	Range	Mean	Deviation	Comparison of Class Means: Classes	Observed Differences	Standard Error of Differences	Critical Ratio
	A	B	C	D	E	F	G
1. Chronological Age							
Class I	76-80	78.1	1.1	Classes I and II	2.8	.36	±7.78*
Class II	74-78	75.3	1.2	Classes II and III	2.3	.39	±5.90*
Class III	70-75	73.0	1.3	Classes I and III	5.1	.45	±11.30*
2. Mental Age							
Class I	73-108	85.0	8.1	Classes II and I	3.4	3.40	±1.00
Class II	64-124	88.4	13 3	Classes II and III	8.1	2.45	±3.31*
Class III	68-101	80.3	8.0	Classes I and III	4.7	2.53	±1.85
3. Intelligence Quotient							
Class I	91-131	107.7	9.2	Classes II and I	7.2	3.65	±1.97
Class II	84-148	114.9	14.1	Classes II and III	5.0	3.62	±1.38
Class III	96-130	109.9	8.5	Classes III and I	2.2	2.66	±.83

* Significant at .05 level of confidence

NOTE: Under Comparison of Class Means, the class with the larger mean is given first

Public School from September to November, 1963 has been presented in this chapter. The pilot study, test population, testing instruments, testing procedures, and statistical treatment of the data were described. The analysis and interpretation of the data obtained will be reported in Chapter IV.

CHAPTER IV

ANALYSIS OF DATA AND INTERPRETATION OF RESULTS

This chapter is concerned with the analysis and interpretation of the data obtained from testing sixty-two grade one entrants in three classrooms of a Saskatoon Public School during the first ten weeks of the 1963-64 school term. Tests of intelligence, reading aptitude, and learning methods provided statistical data which are shown in tabular form and then analyzed and explained.

I. ORGANIZATION OF THE ANALYSIS

The analysis will be reported under the following headings:

A. Description of Tables

B. Interpretation of Intercorrelations and Mean Scores
   1. Chronological age
   2. Intelligence tests
   3. Visual tests
   4. Auditory tests
   5. Kinaesthetic-motor tests
   6. Combination tests

C. Summary of Test Results

D. Interpretation of the Analyses of Variance
   1. Sex versus Methods--Analysis of Variance I
   2. Mental Age versus Methods--Analysis of Variance II
   3. Chronological Age versus Methods--Analysis of Variance III
   4. Classes versus Methods--Analysis of Variance IV

E. Summary of Findings from the Analyses of Variance

F. Summary Statement

II. DESCRIPTION OF THE TABLES

Table I, page 49, shows the number of participants in the testing program, the range of means and standard deviations obtained for chronological age (as recorded when the Learning Methods Test was administered) and mental age and intelligence quotients scored on the Pintner-Cunningham Primary Test. The table records the results for the total sample and for the boys and girls separately. The means of boys and girls are compared, and observed differences, standard error of the differences, and critical ratios are shown. Asterisks indicate where these differences are significant.

Table II, page 91, shows a comparison of chronological age, mental age, and intelligence quotients for the three classes that participated in the experiment. In columns A, B, and C the range, mean and standard deviations are given for each of the classes on each of the three variables. In columns D through G the means of the classes are compared in pairs with observed differences, standard error of the differences, and the critical ratios shown for each comparison. Where the differences are significant they are marked with asterisks.

Tables III, VII, XII, and XVI on pages 102, 119, 134, and 149 are summaries of results for the total group, boys, and girls on the visual, auditory, kinaesthetic-motor, and combination tests respectively. The range of means and standard deviations are shown for the total group and for each of the sexes, and a comparison of means for boys and girls has been made, showing observed differences, standard error of the differences and critical ratios. Significant ratios have been indicated by asterisks.

Tables IV to XIX, with the exceptions of Tables VII, XI, XII, and XVI, present the intercorrelations of intelligence and chronological age with the visual, auditory, kinaesthetic-motor, and combination tests. Correlations significant at the .01 level of confidence are underlined in red; those that are significant at the .05 level are underlined in green. The intercorrelations have been grouped in tables. The first numbered table in each group contains the results for the total group, the second the results for the boys, and the third the results for the girls. They have been grouped as follows:

Tables IV, V, and VI--Visual tests (pages 103, 105, and 106)

Tables VIII, IX, and X--Auditory tests (pages 121, 123, and 124)

Tables XIII, XIV, and XV--Kinaesthetic-Motor tests (pages 137, 138, and 139)

Tables XVII, XVIII, and XIX--Combination tests (pages 151, 152, and 153)

Table XI, page 131, shows the correlations of the Monroe Reading Aptitude subtest of Word Discrimination and Sequence with selected visual tests for the total group, boys, and girls. As in the tables described above, the correlations significant at the .01 level are underlined in red, and those significant at the .05 level are underlined in green.

Tables XX, XXII, XXIV, and XXV on pages 162, 167, 172 and 175 are the summary tables for the four analyses of variance--Sex versus Methods, Mental Age versus Methods, Chronological Age versus Methods, and Classes versus Methods. The sums of squares, degrees of freedom, mean squares, and F ratios are shown. Where the F ratios have attained significance they are marked with asterisks.

Tables XXI, XXIII, XXVI, XXVII, XXVIII, and XXIX on pages 164, 169, 177, 179, 180 and 182 present the tests on means using the Newman-Keuls procedure as given in Winer (1962, p. 309). Each table is divided into three sections. The first section shows the ordered means and all the possible differences between pairs of ordered means. The second section shows the standard error of the factor being tested, the truncated range for the ordered means, the studentized truncated range, and the

critical values--the product of the standard error multiplied by the studentized truncated range. In the third section of the table the significant differences in means are indicated by asterisks.

III. INTERPRETATION OF INTERCORRELATIONS AND MEAN SCORES

Chronological Age

The data with regard to the test population, presented in Table I, page 49, shows that the chronological age span for the total group was 10 months, with a range of from 70 to 80 months, a mean of 75.6, and a standard deviation of 2.3 months. The boys ranged in age from 70 to 79 months with a mean of 74.7 and a standard deviation of 2.3 months while the girls ranged from 71 to 80 months with a mean of 76.4 and the same standard deviation as that of the boys. Comparison of the mean chronological ages of the boys and girls revealed an observed difference of 1.7 favoring the girls. The critical ratio of the difference was $\pm$ 2.93 which was significant beyond the .01 level of confidence. This significant difference would seem to afford the girls a decided advantage in this experiment since it is generally accepted that girls mature more quickly than boys. With the added advantage of a significantly older chronological age mean, we might expect the girls to secure higher means in the areas tested.

Correlations of chronological age with intelligence and the visual (Tables IV to VI, pages 103, 105, and 106), auditory (Tables VIII, IX, and X, pages 121, 123, and 124), kinaesthetic-motor (Tables XIII, XIV, and XV, pages 137, 138, and 139), and combination test results (Tables XVII, XVIII, and XIX, pages 151, 152, and 153) for boys and girls separately, showed negative or indifferent results in almost every case. Only three tests showed significant correlations with chronological age. These three tests were: Associated Objects from the Pintner-Cunningham Primary for the total group (.26, Table IV--4D), Monroe Auditory Memory for the total group (.26, Table VIII--7G) and for the boys (.40, Table IX--7G), and Monroe Auditory Aptitude Total for the total group (.31, Table VIII--8H) and for the boys (.45, Table IX--8H). All of these correlations were significant at the .05 level of confidence. Although the mean differences favored the girls, significantly so in the case of the Auditory Aptitude Total (Table VII--F), the results showed practically no correlation with chronological age for the girls. The correlations cited above suggest that a maturation factor is present in the development of these auditory abilities since the performance of the older boys was significantly better than that of the younger boys. The girls, who were on the average signifi-

[illegible] of [illegible]

[illegible] (Tables IV [illegible], pages [illegible], [illegible], and [illegible]);

[illegible] (Tables XIII, [illegible], and [illegible], pages [illegible] and

[illegible] (Tables [illegible], pages [illegible] and [illegible]

[illegible] and [illegible] [illegible] (Tables

XVII, XVIII, and XXI, pages [illegible], [illegible], and [illegible])

[illegible] [illegible], [illegible] [illegible]

[illegible]

significant [illegible] [illegible]

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All of these [illegible]

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cantly older and who tend as a group to mature more quickly than boys, apparently had reached a stage of maturity where differences in chronological age contribute little to success in these measurements of auditory ability. It is possible that the girls have had more experience in listening since girls tend to engage in more sedentary activities in their pre-school years than do boys. The same type of activities may be largely responsible for the lack of correlation between the visual test of Associated Objects and chronological age for girls, but further discussion of these tests will be reserved for later in the appropriate sections.

Intelligence

Mental age and intelligence quotient. Reference to Table I, page 49, shows that the total group ranged in mental age from 64 months to 124 months with a mean of 84.6 and a standard deviation of 10.4 months. The boys ranged in mental age from 64 to 124 months with a mean of 82.9 months and a standard deviation of 12.4 months, as compared to the mental ages of the girls which ranged from 73 to 108 months with a mean of 86.2 and a standard deviation of 7.8 months. The greater variability of the boys' mental ages was significant at the .01 level of confidence. However, the conventional "t" test yielded no significant

mean differences between boys and girls, and this ratio became even less significant when tested by the Cochran and Cox formula as given in Ferguson (1959, p. 143).

The range of intelligence quotients for the entire group was from 84 to 148 with a mean of 110.7 and a standard deviation of 11.1. Again the boys' quotients showed a greater, although non-significant, variability with a range of from 84 to 148, a mean of 109.8 and a standard deviation of 12.6 as compared to the girls, whose intelligence quotients ranged from 91 to 131 with a mean of 111.7 and a standard deviation of 9.5. None of these differences was significant at the accepted five and one per cent levels of confidence.

From the foregoing information we can assume that the boys and girls in this sample were approximately equal in intelligence. The boys showed greater variability in both intelligence quotients and mental ages but only the variability of the latter was statistically significant. The relationship of intelligence to performance on the visual, auditory, kinaesthetic-motor, and combination tests will be discussed under the heading of these tests in the subsections which follow.

<u>Visual Tests</u>

<u>Comparison of means for the boys and girls</u>. Table

III which shows a comparison of means on the visual tests reveals that the observed differences favored the girls on nine out of the thirteen tests but the only significant difference was in the _Pintner-Cunningham Primary_--Picture Completion Test on which the critical ratio was $\pm$ 2.06. This ratio reached statistical significance at the accepted five percent level. The boys' means were higher than those of the girls on the _Monroe Reading Aptitude_ subtest of Ocular-Motor Control, the Visual Immediate Recall and Visual Delayed Recall of the _Learning Methods Test_, but the observed differences were non-significant. On the _Visual Discrimination Test_--Form Total the boys and girls had identical means.

Intelligence and visual tests. The data presented in Table IV shows that the correlations of mental age and intelligence quotient with the thirteen visual tests for the entire group were, with the exception of two tests, significant at the .01 level of confidence. The Visual Immediate Recall of the _Learning Methods Test_ correlated significantly at the .01 level of confidence with mental age (2--O) but non-significantly with intelligence quotient (3--O). However, the Visual Delayed Recall of the _Learning Methods Test_ correlated significantly with these two variables (2P and 3P) at the .05 and .01 levels respectively.

TABLE III

COMPARISON OF VISUAL TEST RESULTS

Number of Pupils Boys: 31 Girls: 31 Total: 62

Visual Tests Name of Test	Means Total	 Boys	 Girls	Standard Deviations Total	 Boys	 Girls	Comparison of Means for Boys and Girls Observed Differences	 Standard Error of Differences	 Critical Ratio
	A	B	C	D	E	F	G	H	I
1. Pintner-Cunningham:									
a) Associated Objects	5.3	5.0	5.5	1.1	1.3	.8	.5	.26	±1.88
b) Picture Parts	11.4	11.1	11.8	2.3	2.6	2.0	.7	.59	±1.19
c) Picture Completion	5.8	5.3	6.3	1.9	2.1	1.5	1.0	.47	±2.06*
d) Dot Drawing	5.3	5.2	5.5	1.6	1.6	1.6	.3	.40	±.75
2. Monroe Reading Aptitude:									
a) Memory of Form Orientation	11.8	11.7	11.9	.6	.6	.5	.2	.14	±1.43
b) Ocular-Motor Control	7.7	7.9	7.4	1.5	1.4	1.4	.5	.37	±1.35
c) Form Memory	5.2	4.6	5.7	2.3	2.4	2.4	1.1	1.83	±1.66
d) Visual Aptitude Total	24.6	24.3	25.0	3.2	3.0	3.0	.7	.81	±.86
3. Visual Discrimination Test:									
a) Form Discrimination	114.3	114.3	114.3	18.7	15.8	15.8	.0	4.78	±.00
b) Letters and Words	58.2	58.2	58.3	5.5	5.5	5.5	.1	1.40	±.71
c) Total Score	172.5	172.5	172.5	21.7	18.6	18.6	.1	5.55	±.18
4. Learning Methods Test:									
a) Immediate Recall-Visual	5.9	6.2	5.7	2.8	2.9	2.9	.5	.72	±.69
b) Delayed Recall-Visual	4.7	5.0	4.4	3.0	3.2	3.2	.6	.77	±.78

* Significant at .05 level of confidence

TABLE IV

INTERCORRELATION OF INTELLIGENCE AND VISUAL TESTS FOR THE TOTAL GROUP

N = 62 Tests Correlated	Chronological Age	P-C.P. M.A.	P-C.P. I.Q.	P-C.P. Assoc. Object	P-C.P. Pict. Parts	P-C.P. Pict. Completion	P-C.P. Dot Drawing	M.R.A.P. Mem. of Orient. of Form	M.R.A.P. Oc.-Mot. Cont.	M.R.A.P. Form Memory	M.R.A.P. Vis. Aptitude	V.D. Form	V.D. Letters & Words	V.D. Grand Total	L. M.T. Vis. Imm. Rec.	L.M.T. Vis. Del. Rec.
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1. Chronological Age		.15	-.13	.25	.04	.24	.07	-.03	-.34	-.11	-.25	-.20	-.10	-.20	-.34	-.28
2. Pintner-Cunningham Primary Mental Age			.95	.45	.62	.74	.62	.34	.34	.42	.53	.48	.32	.49	.32	.27
3. Pintner-Cunningham Primary Intelligence Quotient				.40	.65	.67	.61	.39	.45	.46	.62	.55	.35	.56	.07	.35
4. Pintner-Cunningham Primary Associated Objects					.27	.26	.30	.13	.17	.26	.29	.19	.13	.19	.08	.01
5. Pintner-Cunningham Primary Picture Parts						.31	.34	.20	.19	.28	.33	.34	.21	.34	.16	.07
6. Pintner-Cunningham Primary Picture Completion							.42	.38	.30	.32	.44	.34	.18	.34	.19	.17
7. Pintner-Cunningham Primary Dot Drawing								.56	.41	.40	.58	.65	.37	.65	.31	.26
8. Monroe Reading Aptitude-Primary Memory of Orientation of Form									.38	.21	.51	.48	.36	.50	.06	.01
9. Monroe Reading Aptitude Primary Ocular-Motor Control										.14	.64	.44	.11	.41	.30	.23
10. Monroe Reading Aptitude Primary Form Memory											.84	.33	.32	.36	.29	.14
11. Monroe Reading Aptitude Primary Visual Aptitude Total												.53	.35	.55	.37	.21
12. Visual Discrimination Test I Form Total													.44	.97	.32	.27
13. Visual Discrimination Test II Letters and Words Total														.63	.51	.38
14. Visual Discrimination Test - Grand Total															.40	.32
15. Learning Methods Test - Visual Immediate Recall																.84

Significant at the .01 level
Significant at the .05 level

Some interesting differences may be seen in comparing the correlations of the visual tests with mental age and intelligence quotients in Tables V and VI. The boys' performances on the visual tests showed significant correlations with mental age on eleven out of the thirteen tests, and a twelfth correlation fell one point short of significance, but only one of these tests fell short of the accepted significance level when correlated with intelligence quotient. Visual test performance for the girls gave evidence of significant relationships with mental age on eight out of the thirteen tests and with intelligence quotient on ten out of the thirteen tests. Three of the tests that correlated significantly with intelligence for boys showed negligible relationships with either mental age or intelligence quotient for the girls. These tests were the Associated Objects test of the Pintner-Cunningham Primary, the Monroe Reading Aptitude --Form Memory, and Visual Discrimination--Letters and Words (Tables V and VI--D, J, and M). In the subtest of Associated Objects the child must mark two commonly associated objects (such as coat and hat, table and chair, or lock and key) within a sixty-second time limit. At this point it is interesting to note that the Associated Objects test revealed a relationship with chronological age that was significant at the .05 level of confidence for the

TABLE V

INTERCORRELATION OF INTELLIGENCE AND VISUAL TESTS FOR THE BOYS

N = 31

Tests Correlated	Chronological Age	P-C.P. M.A.	P-C.P. I.Q.	P-C.P. Assoc. Object	P-C.P. Pict. Parts	P-C.P. Pict. Completion	P-C.P. Dot Drawing	M.R.A.P. Mem. of Orient. of Form	M.R.A.P. Oc.-Mot. Cont.	M.R.A.P. Form Memory	M.R.A.P. Vis. Aptitude	V.D. Form	V.D. Letters and Words	V.D. Grand Total	L.M.T. Vis. Imm. Rec.	L.M.T. Vis. Del Rec.
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1. Chronological Age		.18	.29	.28	.03	.26	.21	.18	-.30	-.15	-.05	-.07	-.09	-.07	-.22	-.25
2. Pintner-Cunningham Primary Mental Age			.97	.57	.62	.80	.64	.34	.37	.57	.60	.51	.46	.55	.40	.26
3. Pintner-Cunningham Primary Intelligence Quotient				.55	.68	.75	.61	.37	.46	.63	.68	.55	.49	.59	.48	.32
4. Pintner-Cunningham Primary Associated Objects					.40	.46	.50	.23	.36	.30	.40	.37	.29	.39	.21	.16
5. Pintner-Cunningham Primary Picture Parts						.35	.42	.33	.37	.53	.57	.44	.40	.47	.22	.08
6. Pintner-Cunningham Primary Picture Completion							.59	.49	.42	.49	.59	.40	.36	.43	.36	.19
7. Pintner-Cunningham Primary Dot Drawing								.48	.45	.49	.60	.63	.47	.66	.42	.34
8. Monroe Reading Aptitude-Primary Memory of Orientation of Form									.41	.40	.62	.46	.50	.02	.31	.05
9. Monroe Reading Aptitude Primary Ocular-Motor Control										.32	.72	.39	.13	.37	.34	.22
10. Monroe Reading Aptitude Primary Form Memory											.87	.42	.40	.45	-.01	.29
11. Monroe Reading Aptitude Primary Visual Aptitude Total												.53	.39	.54	.30	.08
12. Visual Discrimination Test I Form Total													.50	.98	.34	.27
13. Visual Discrimination Test II Letters and Words Total														.66	.48	.30
14. Visual Discrimination Test - Grand Total															.40	.30
15. Learning Methods Test - Visual Immediate Recall																.78

Significant at the .01 level

Significant at the .05 level

TABLE VI

INTERCORRELATION OF INTELLIGENCE AND VISUAL TESTS FOR THE GIRLS

N = 31

	Tests Correlated	Chronological Age	P-C.P. M.A.	P-C.P. I.Q.	P-C.P. Assoc. Object	P-C.P. Pict. Parts	P-C.P. Pict. Completion	P-C.P. Dot Drawing	M.R.A.P. Mem. of Orient. of Form	M.R.A.P. Oc.-Mot. Cont.	M.R.A.P. Form Memory	M.R.A.P. Vis. Aptitude	V.D. Form	V.D. Letters and Words	V.D. Grand Total	L.M.T. Vis. Imm. Rec.	L.M.T. Vis. Del. Rec.
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1.	Chronological Age		-.01	-.38	.04	-.08	.04	-.13	-.21	-.30	-.28	-.40	-.41	-.22	-.41	-.43	-.29
2.	Pintner-Cunningham Primary Mental Age			.92	.06	.60	.59	.60	.31	.42	.19	.41	.43	.11	.40	.28	.36
3.	Pintner-Cunningham Primary Intelligence Quotient				.03	.61	.53	.62	.40	.49	.26	.51	.56	.17	.52	.39	.42
4.	Pintner-Cunningham Primary Associated Objects					-.07	-.34	-.06	-.12	-.01	.11	.06	-.22	-.15	-.23	-.06	-.17
5.	Pintner-Cunningham Primary Picture Parts						.16	.22	-.02	.04	-.08	-.04	.17	-.03	.14	.12	.09
6.	Pintner-Cunningham Primary Picture Completion							.18	.16	.30	.01	.18	.26	-.05	.21	.06	.22
7.	Pintner-Cunningham Primary Dot Drawing								.64	.42	.29	.55	.69	.27	.66	.22	.22
8.	Monroe Reading Aptitude-Primary Memory of Orientation of Form									.44	-.02	.37	.52	.32	.53	-.02	.08
9.	Monroe Reading Aptitude Primary Ocular-Motor Control										.07	.61	.55	.09	.50	.24	.23
10.	Monroe Reading Aptitude Primary Form Memory											.81	.25	.26	.29	.45	.31
11.	Monroe Reading Aptitude Primary Visual Aptitude Total												.56	.31	.57	.46	.37
12.	Visual Discrimination Test I Form Total													.37	.96	.30	.27
13.	Visual Discrimination Test II Letters and Words Total														.61	.54	.46
14.	Visual Discrimination Test - Grand Total															.42	.37
15.	Learning Methods Test - Visual Immediate Recall																.89

Significant at the .01 level

Significant at the .05 level

total group, somewhat below this significance level for the boys, and negligible for the girls (Tables IV, V, and VI--1A). Since the observed difference in means on this test favored the girls (Table III, page 102) it would appear that the girls have reached a certain level of maturity where differences in chronological age or intelligence contribute little towards success in quick discrimination of the commonly associated objects represented by the pictures. Both the Monroe Reading Aptitude--Form Memory and Visual Discrimination--Letters and Words require fine discrimination and orientation in space. The extensive research of Gesell (1953) has stressed that visual acuity is partly a product of maturation, with near-point acuity developing later than far-point acuity. Since visual discriminatory powers are, in part, dependent upon satisfactory near-point acuity, it is possible that the chronological age advantage and pre-school experiences of the girls in this sample have enabled them to develop finer powers of discrimination than the boys and to offset the effect that differences in intelligence might have had. Regarding problems of orientation in space, the literature abounds with research to support the hypothesis that younger children have more difficulty with reversals, transpositions, and confusable symbols. The success of the girls on the tests of Form Memory and Letters and Words

gives further support to this hypothesis, especially when we note the negligible correlations of these tests with intelligence for the girls.

Interrelationship of the visual tests. Tables IV, V, and VI, on pages 103, 105, and 106, present the intercorrelations of the thirteen visual test scores for the total group, boys, and girls respectively. The interrelationship of these tests will be discussed under the headings of the four main tests involved.

Pintner-Cunningham Primary Test. Four subtests of the *Pintner-Cunningham Primary* were selected as having a high visual perceptual "loading." The boys' performances on these tests (Table V) were significantly related to a comparatively large number of the other twelve visual tests as indicated by the number in parentheses after each subtest title: Associated Objects (7), Picture Parts (9), Picture Completion (11), and Dot Drawing (11). However, the correlations for the girls (Table VI) on the first three of the above tests were not significantly related to *any* of the other visual tests and in Dot Drawing the correlations were significant correlations for only five of the tests as compared to the eleven significant correlations for the boys on this test. It should be noted that all of the tasks on these subtests had to be completed

within rigid time limits which ranged from ten to thirty seconds. The only other test with such a rigid time limit was that of the Monroe Reading Aptitude--Form Memory which required the child to reproduce correctly as many of the geometric designs as he could recall after a ten-second exposure.

Some observations with regard to the five subtests of the Pintner-Cunningham seem pertinent at this point. In addition to the specific visual perceptual abilities measured on these tests a speed of discrimination is involved in each test. The observed differences in means all favor the girls, and on one of these, Picture Completion, the difference is significant at the .05 level of confidence. There is also a markedly lower number of significant correlations between these five tests and the other visual tests for the girls, than for the boys. In the previous discussion of the interrelationship of the visual tests with intelligence, it was noted that the subtests of Associated Objects and the Monroe Form Memory did not show any appreciable relationship with intelligence for the girls, but all of these tests were significantly correlated with intelligence for the boys. It is possible that a visual maturity factor and/or previous experience with similar visual tasks may be responsible for the differential performance of the girls on these tests.

Associated Objects correlated significantly with five of the other visual tests for the total group (Table IV--D), with seven for the boys (Table V--D), and with one for the girls (Table VI--D). For the total group and for the boys, it was significantly related to Picture Parts, Picture Completion, Dot Drawing, and the Monroe Visual Aptitude Total.

Picture Parts correlated significantly with seven out of the other twelve visual tests for the total group (Table IV--E): <u>Pintner-Cunningham Primary</u>--Associated Objects, Picture Completion, Dot Drawing; <u>Monroe Reading Aptitude</u>--Form Memory, Visual Aptitude Total; <u>Visual Discrimination</u>--Form Total, Grand Total. For the boys (Table V--E) this test showed significant correlations with the same tests as for the total group and in addition, two other tests: <u>Monroe Reading Aptitude</u>--Ocular-Motor Control and <u>Visual Discrimination</u>--Letters and Words. All of the correlations of this test with the other visual tests for the girls (Table VI--E) were either negative or negligible.

Total group performance on the test of Picture Completion correlated significantly with all but three of the other visual tests (Table IV--F). The three tests that failed to correlate significantly with any of the other tests for the total group were: <u>Visual Discrimina-</u>

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[illegible] significantly [illegible]
five of the other flowers[illegible] the total group (Table 17—4), with [illegible] (Table [illegible]), and [illegible] for the grain [illegible] (Table 17-8). [illegible] the total group and the twelve, it was significantly [illegible] Picture Completion, [illegible] Arithmetic [illegible]

[illegible] out of the other twelve (Table [illegible]) (Table [illegible]). [illegible] [illegible] [illegible] [illegible] [illegible] (Table [illegible]) [illegible] with the [illegible] [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] (Table [illegible]) [illegible] [illegible]

[illegible] [illegible] [illegible] of the [illegible] [illegible] of the [illegible] (Table [illegible]). [illegible] that [illegible] [illegible] other [illegible] for the total group [illegible] [illegible]

tion--Letters and Words, and the Visual Immediate Recall and Visual Delayed Recall of the Learning Methods Test. None of the correlations for Picture Completion was significant for the girls, and the only one even approaching significance level was that of Ocular-Motor Control (Table VI--F). However, for the boys this test correlated significantly with all of the other visual tests except the Visual Delayed Recall of the Learning Methods Test (Table V--F).

Dot Drawing showed significant correlations with all of the other visual tests for the total group (Table IV--G), with eleven for the boys (Table V--G), and with five for the girls (Table VI--G). For the total group, and boys and girls separately, this test was significantly related to the Monroe tests of Memory of Orientation of Form, Ocular-Motor Control and Visual Aptitude Total and the Visual Discrimination--Form Total and Grand Total. The boys' results on this test correlated significantly with all the other visual tests except the Visual Delayed Recall of the Learning Methods Test, and this relationship was only one point below the accepted significance level.

Monroe Reading Aptitude--Visual Aptitude. Memory of Orientation of Form showed a significant relationship

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[illegible] (Table 7-1.)

[illegible]

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with seven of the other twelve visual tests for the total group (Table IV--H) and for the boys (Table V--H) and with five of the tests for the girls (Table VI--H). For total group, and boys and girls separately, it correlated significantly with four of the tests: Form Total of the Visual Discrimination Tests, Dot Drawing, Ocular-Motor Control, and Visual Aptitude Total. In addition to these tests for the boys it correlated significantly with Letters and Words Total of the Visual Discrimination Tests, Picture Completion and Form Memory. In contrast to the high relationship between this test and the Grand Total of the Visual Discrimination Tests for the girls, .53, the interrelationship of these two tests for the boys, .02, was negligible.

Ocular-Motor Control was significantly correlated with the same five tests for the total group, boys and girls: Dot Drawing, Memory of Orientation of Form, Visual Aptitude Total and the Visual Discrimination Tests--Form Total and Grand Total (Tables IV, V, and VI--I). It was not significantly related to any of the other tests for the girls but for the boys it showed significant correlations with the other three subtests of the Pintner-Cunningham--Associated Objects, Picture Parts, and Picture Completion.

The subtest of Form Memory showed significant correlations with nine other visual tests for the total

group, eight for the boys, and two for the girls (Tables IV, V, and VI-J). The only similarity in the intercorrelations for the boys and girls on this test was in the high relationship to Visual Aptitude Total, .87 and .81, for boys and girls respectively. It is interesting to note the high correlation of this test with the Visual Immediate Recall of the Learning Methods Test (.45 for the girls in contrast to -.01 for the boys). Differentiation of gross and minute detail, sequence of letters and figures, and orientation in space are involved in both of these tests. It appears that the girls in this sample utilized more of the same type of clues to aid in their recall of both geometric forms and words than did the boys in the sample.

Visual Aptitude Total showed a significant relationship with five of the same tests for the entire group, and boys and girls separately (Tables IV, V, and VI--K). The five tests were: the Grand Total of the Visual Discrimination Tests, Dot Drawing, Memory of Orientation of Form, Ocular-Motor Control and Form Memory. In addition, it correlated significantly with the other three subtests of the Pintner-Cunningham, with the Letters and Words Total of the Visual Discrimination Tests for the total group and for the boys, and with the two recall tests of the Learning Methods Test for the girls.

An overview of the correlations for the subtests of the Monroe Visual Aptitude shows that the boys' and girls' performances on Memory of Orientation of Form correlated significantly with Ocular-Motor Control, but the correlations of these two tests with Form Memory were not very high for the boys, and were negative or negligible for the girls. When ranked in order of their relationship with the Visual Aptitude Total the subtests would appear as follows with the correlations for the boys appearing first and those for the girls second within the parentheses: (1) Form Memory (.87 and .81), (2) Ocular-Motor Control (.72 and .61), and (3) Memory of Orientation of Form (.62 and .37).

Visual Discrimination Tests. The Form Total (Item 12--L) showed a significant relationship with six of the other tests for the total group, for the boys, and for the girls: the Grand Total of the Visual Discrimination Test, Dot Drawing, Memory of Orientation of Form, Ocular-Motor Control, Visual Aptitude Total, and the Letters and Words Total. In addition to the above tests, it was significantly related to Picture Parts, Picture Completion, and Form Memory for the total group and for the boys, to Associated Objects for the boys, and to the two recall tests of the Learning Methods Test (Visual

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Method) for the total group. In all then, this test related significantly to eleven, ten, and eight other visual tests for the total group, boys, and girls respectively.

Letters and Words Total correlated significantly with eight of the other twelve tests for the total group, nine for the boys, and four for the girls. Both the boys' and girls' performances on the test showed significant correlations with the Form Total and Grand Total of the _Visual Discrimination Tests_. However, while this test showed no significant correlations for the girls, with any of the subtests of the _Pintner-Cunningham_ or _Monroe Reading Aptitude_, for the boys, it related significantly to three of the former--Dot Drawing, Picture Parts and Picture Completion and to three of the subtests of the latter--Memory of Orientation of Form, Form Memory, and Visual Aptitude Total. The girls' performance on this test related significantly (at the .01 level of confidence) to the Visual Delayed Recall of the _Learning Methods Test_, .46, but the same correlation for the boys was much lower, .30.

The Grand Total of the _Visual Discrimination Test_ was significantly related to eleven of the other visual tests for the total group, ten for the boys, and eight for the girls. For the total group the only test with

which the Grand Total failed to correlate significantly was Associated Objects. The boys' results on the test correlated significantly with all but two of the other tests--Memory of Orientation of Form and the Visual Delayed Recall of the Learning Methods Test. Unlike those of the boys, the correlation of this test with Memory of Orientation of Form for the girls, .53, was significant at well beyond the .01 level of confidence.

Learning Methods Test--Visual Method. Significant correlations are shown between Immediate Recall and eight of the other twelve visual tests for the total group, five tests for the boys, and five tests for the girls. For both boys and girls it was significantly related to Letters and Words and the Grand Total of the Visual Discrimination Tests and to the Visual Delayed Recall of the Learning Methods Test. Boys' results were also significantly related to Picture Completion, .36, and Dot Drawing, .42, of the Pintner-Cunningham Test although these same correlations were low or negligible for the girls. On the other hand, girls' results correlated significantly with Form Memory, .45, and Visual Aptitude Total, .46, of the Monroe Reading Aptitude tests.

Visual Delayed Recall correlated significantly with Visual Immediate Recall for total group, .84, for

the boys, .78, and for the girls, .89. For the girls this test reached a significant level of correlation with three other tests--Visual Aptitude Total, .37, and the Letters and Words, .46 and Grand Total, .37, of the Visual Discrimination Tests while these same correlations for the boys were, .08, .30, and .30 respectively. The correlations of Visual Delayed Recall with Dot Drawing for the boys, .34, fell just short of the accepted significance level.

Summary. There was a very significant relationship between the visual test scores and measured intelligence for the total group. However, fewer of the visual tests correlated significantly with intelligence for the girls than for the boys and on the whole the girls' correlations tended to be lower than those of the boys. The girls' mean performance was superior to that of the boys on nine of the thirteen visual tests but the only significant difference was on the test of Picture Completion. The boys performed slightly better than the girls on the recall tests of the Learning Methods Test and had identical means on the Visual Discrimination Tests--Form Total. The visual subtests for the boys showed a much higher number of significant interrelationships than did those of the girls. The boys attained significant intercorrelations between the subtests of the Pintner-Cunningham Primary Test and the other visual tests, whereas, with the exception of Dot

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[illegible] were five two groups, [illegible]. The [illegible] revealed a significant level of correlation with other [illegible] [illegible] and the [illegible] [illegible], the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Summary. There was a very slight trend [illegible] between the groups [illegible] for the [illegible] groups. However, [illegible] of the [illegible] correlated significantly with [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] differences [illegible] performed slightly better [illegible] tests of the Illinois Test [illegible] on the Visual Discrimination Test [illegible] [illegible] significant [illegible] [illegible] the [illegible] the visual tests, however, [illegible]

Drawing, these subtests correlated either negligibly or negatively with the other tests for the girls. Learning to recognize words by a method which stresses the visual components of the words (as in the Visual Method of the _Learning Methods Test_) was significantly correlated with Picture Completion and Dot Drawing for the boys, with Form Memory and Visual Aptitude Total for the girls and with the Letters and Words and the Grand Total of the _Visual Discrimination Tests_ for both boys and girls. Evidently the girls, as compared to the boys in the sample, were able to make faster visual discriminations and made more use of word-form clues in learning to recognize words.

Auditory Tests

Comparison of means for the boys and girls. The comparison of auditory test results recorded in Table VII reveals that on five of the seven auditory tests the observed differences in means favored the girls and two of the differences were significant beyond the .05 level of confidence. The girls' mean on the Monroe Sound Blending (2b--G, and I) was significantly higher than that of the boys with a critical ratio of $\pm$ 2.23 which was significant at the .05 level of confidence. Mean differences on the Monroe Auditory Aptitude Total (2d--G, and I) also favored the girls with a critical ratio of $\pm$ 2.58 which

TABLE VII

COMPARISON OF AUDITORY TEST RESULTS

Number of Pupils Boys: 31 Girls: 31 Total: 62

Auditory Tests	Means			Standard Deviations			Comparison of Means for Boys and Girls		
Name of Test	Total	Boys	Girls	Total	Boys	Girls	Observed Differences	Standard Error of Differences	Critical Ratio
	A	B	C	D	E	F	G	H	I
1. Wepman Auditory Discrimination	59.5	58.7	60.3	5.8	6.9	4.4	1.6	1.47	±1.08
2. Monroe Reading Aptitude:									
a) Word Discrimination and Sequence	6.6	6.4	6.8	1.6	1.6	1.7	.4	.41	±.97
b) Sound Blending	9.1	8.7	9.6	1.6	1.5	1.5	.9	.39	±2.23*
c) Auditory Memory	13.3	12.7	13.9	4.1	4.0	4.3	1.2	1.33	±.90
d) Auditory Total	29.0	27.9	30.2	5.0	4.8	5.1	2.3	.91	±2.58*
3. Learning Methods Test:									
a) Immediate Recall - Auditory	5.8	6.0	5.7	3.1	2.9	3.4	.3	.80	±.37
b) Delayed Recall - Auditory	4.4	4.8	4.1	3.0	2.8	3.2	.7	.76	±.92

*Significant at the .05 level of confidence

was significant beyond the .02 level of confidence. Mean differences on both Immediate and Delayed Recall of the Learning Methods Test favored the boys, but the differences were non-significant (3a and 3b--G, and I). Since it has already been pointed out that the girls' performances on the subtests and total test of Monroe Auditory Aptitude showed a negligible or negative relationship with intelligence, it is apparent that their chronological age advantage and/or advanced maturity have enabled them to develop their auditory aptitudes to a significantly higher level than that of the boys. Auditory discrimination and memory for a sequence of sounds are involved in all of the subtests of the Aptitude Total. It is possible that girls mature more quickly than boys in these auditory abilities.

Intelligence and auditory tests. An examination of Table VIII, which presents the intercorrelations of intelligence and auditory tests for the total group, shows that only four of the seven auditory tests attained significant correlations with intelligence. The correlations of mental age and intelligence quotient with Wepman Auditory Discrimination were .34 and .37 respectively, and with Monroe Reading Aptitude--Word Discrimination and Sequence were .37 and .37, all significant at the .01 level of confidence. The relationship of Monroe Reading Aptitude

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[illegible]

TABLE VIII

INTERCORRELATION OF INTELLIGENCE AND AUDITORY TESTS FOR

THE TOTAL GROUP

N = 62 Tests Correlated	Chronological Age	P-C. P. M.A.	P-C. P. I.Q.	Wepman Auditory Dis.	M.R.A.P. Word Discr. & Seq.	M.R.A.P. Sound Blending	M.R.A.P. Auditory Memory	M.R.A.P. Auditory Apt. Total	L.M.T. Auditory Imm. Recall	L.M.T. Auditory Del. Rec.
	A	B	C	D	E	F	G	H	I	J
1. Chronological Age		.15	-.13	-.02	.10	.18	.26	.31	-.32	.23
2. Pintner-Cunningham Primary Mental Age			.95	.34	.37	.25	.04	.23	.25	.23
3. Pintner-Cunningham Primary Intelligence Quotient				.37	.36	.21	-.05	.14	.36	.29
4. Wepman Auditory Discrimination Test					.07	.11	-.13	-.05	.39	.33
5. Monroe Reading Aptitude Primary Word Discrimination and Sequence						.15	-.01	.37	-.09	-.07
6. Monroe Reading Aptitude Primary Sound Blending							.17	.50	-.09	-.14
7. Monroe Reading Aptitude Primary Auditory Memory								.88	.01	.11
8. Monroe Reading Aptitude Primary Auditory Aptitude Total Score									-.05	.02
9. Learning Methods Test Auditory Immediate Recall										.80

Significant at the .01 level ——

Significant at the .05 level ——

--Sound Blending with mental age, .25, was barely significant at the .05 level and was non-significant with intelligence quotient, .21. Although only just significant at the .05 level with mental age, .25, the correlation of the Auditory Immediate Recall of the Learning Methods Test was significant at the .01 level with intelligence quotient, .36. This same pattern, but with lower correlation, was followed in the relationship of the Delayed Recall Test of the Learning Methods Test with mental age, .23, and intelligence quotient, .25. It would seem that in spite of the negligible or negative correlation of chronological age with the auditory tests, some maturity factor is present in the development of these auditory abilities.

When the correlations of boys and girls are compared, some variations deserve close examination (Tables IX and X, 2 and 3 with D to J). None of the auditory tests attained correlations which were significant at the .01 level of confidence with intelligence, and only two were significant at the .05 level for girls. The relationship of the Wepman Auditory Discrimination Test with both mental age, .49, and intelligence quotient, .52, was significant at the .01 level for the boys while this same test for the girls showed negligible or negative correlations (-.09 with mental age and .04 with intelligence

TABLE IX

INTERCORRELATION OF INTELLIGENCE AND AUDITORY TESTS FOR THE BOYS

N = 31

Tests Correlated	Chronological Age	P-C. P. M.A.	P-C. P. I.Q.	Wepman Auditory Dis.	M.R.A.P. Word Discr. & Seq.	M.R.A.P. Sound Blending	M.R.A.P. Auditory Memory	M.R.A.P. Auditory Apt. Total	L.M.T. Auditory Imm. Recall	L.M.T. Auditory Del. Rec.
	A	B	C	D	E	F	G	H	I	J
1. Chronological Age		.18	-.03	.07	.17	.19	.40	.45	-.25	-.09
2. Pintner-Cunningham Primary Mental Age			.97	.49	.43	.26	.16	.36	.31	.23
3. Pintner-Cunningham Primary Intelligence Quotient				.52	.43	.22	.05	.25	.39	.25
4. Wepman Auditory Discrimination Test					.13	.23	-.14	-.00	.43	.38
5. Monroe Reading Aptitude Primary Word Discrimination and Sequence						.11	-.02	.35	-.01	-.04
6. Monroe Reading Aptitude Primary Sound Blending							.12	.46	-.06	-.16
7. Monroe Reading Aptitude Primary Auditory Memory								.88	.17	.32
8. Monroe Reading Aptitude Primary Auditory Aptitude Total Score									.12	.25
9. Learning Methods Test Auditory Immediate Recall										.74

Significant at the .01 level
Significant at the .05 level

TABLE X

INTERCORRELATION OF INTELLIGENCE AND AUDITORY TESTS FOR THE

GIRLS

N = 31 Tests Correlated	Chronological Age	P-C. P. M.A.	P-C. P. I.Q.	Wepman Auditory Dis.	M.R.A.P. Word Discr. & Seq.	M.R.A.P. Sound Blending	M.R.A.P. Auditory Memory	M.R.A.P. Auditory Apt. Total	L.M.T. Auditory Imm. Recall	L.M.T. Auditory Del. Rec.
	A	B	C	D	E	F	G	H	I	J
1. Chronological Age		-.10	-.37	-.32	-.03	-.01	.07	.05	-.39	-.30
2. Pintner-Cunningham Primary Mental Age			.92	-.09	.31	.16	-.20	-.02	.22	.31
3. Pintner-Cunningham Primary Intelligence Quotient				.04	.27	.16	-.21	-.04	.35	.39
4. Wepman Auditory Discrimination Test					-.03	-.17	-.19	-.22	.39	.36
5. Monroe Reading Aptitude Primary Word Discrimination and Sequence						.14	-.02	.36	-.15	-.09
6. Monroe Reading Aptitude Primary Sound Blending							.15	.47	-.10	-.07
7. Monroe Reading Aptitude Primary Auditory Memory								.88	-.10	-.03
8. Monroe Reading Aptitude Primary Auditory Aptitude Total Score									-.17	-.07
9. Learning Methods Test Auditory Immediate Recall										.85

Significant at the .01 level ———
Significant at the .05 level ———

quotient). Similarily, the Monroe Reading Aptitude--Word Discrimination and Sequence attained a correlation significant at the .05 level with mental age, .43, and with intelligence quotient, .43, for boys but a non-significant relationship with these two variables, .31 and .27 respectively, for the girls. Wepman (1960) found a low relationship between intelligence and the development of auditory discrimination, but he pointed out that the more intelligent child generally scores higher in auditory discrimination tasks because he attends to his task better. Wepman, Thompson (1963), and others have found significant evidence that auditory discrimination is developmental in nature and with some children it may not be fully developed before the end of the seventh year. The girls were significantly older than the boys in this sample and it may be that their auditory-discriminatory abilities have matured sufficiently to offset the effect of differences in intelligence on a pure measure of auditory discrimination. (Evidence that the Wepman Auditory Discrimination Test is a purer measure of this ability than are the other tests will be presented later.)

The Monroe Reading Aptitude--Total Score was significantly correlated with mental age, .36, at the .05 level but was non-significantly related to intelligence quotient for the boys. For the girls, this Total Score

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showed low negative correlations with mental age and intelligence quotient.

The correlations of the recall tests of the *Learning Methods Test* are somewhat contradictory. Neither recall test correlated significantly with mental age for either boys or girls. For the boys, Auditory Immediate Recall was significant at the .05 level with intelligence quotient, .39, but Auditory Delayed Recall, .25, was non-significant. However, the correlations of intelligence quotient with both Auditory Immediate Recall, .35, and Auditory Delayed Recall, .39, were significant at the .05 level of confidence for the girls.

The two tests that showed little correlation with intelligence for either sex were the *Monroe Reading Aptitude* subtests of Sound Blending and Auditory Story Memory.

Interrelationship of the auditory tests. Tables VIII, IX, and X on pages 121, 123, and 124, present the intercorrelations of the seven auditory subtests for the total group, boys, and girls. The interrelationship of these tests will be discussed under the headings of the three main tests involved.

Wepman Auditory Discrimination. The total group performance on the *Wepman Auditory Discrimination* test

showed a negligible or negative correlation with all other auditory tests except the Learning Methods Test on which the correlation of Wepman Auditory Discrimination with Immediate Recall, .39, and Delayed Recall, .33, was significant at the .01 level of confidence. This same pattern held true for both boys and girls. Again the recall tests of the Learning Methods Test were significantly correlated with the Wepman Auditory Discrimination test but this time at the .05 level of significance. Apparently the ability to discriminate between similarities and differences in words is much more closely related to success in learning to recognize words by an auditory or phonic method than are the abilities measured by the other auditory tests.

Monroe Reading Aptitude--Auditory Aptitude. The auditory subtests of the Monroe Reading Aptitude test correlated with the Auditory Aptitude Total with correlations that ranged from barely significant to very high (Tables VIII, IX, and X--E, F, G, and H). However, they showed little relationship with one another or with the other auditory tests.

Auditory Memory, a test of story memory, which measures the child's ability to retell what he can recall of a story that has just been read to him, showed a consistently high relationship to the Auditory Aptitude Total,

.88, for total group, boys, and girls. The test of Sound Blending showed a correlation with Auditory Aptitude Total that was significant at the .01 level for the entire group, .50, for the boys, .46, and for the girls, .47. Word Discrimination and Sequence showed the lowest correlation with the Auditory Aptitude Total and although it was significant at the .01 level for the total group, .37, it was barely significant at the .05 level for the boys, .35, and girls, .36.

The low interrelationship of these subtests seemed to warrant a more careful examination. Auditory discrimination and memory for sequence are required in all the three subtests, but the type and degree of each vary from test to test. Word Discrimination and Sequence requires the child to identify the picture, to select from three similar sounding words the one that matches the picture, and to note the position (i.e. first, second, or third) of the correct word in the sequence of words that he has heard. Sound Blending requires the child to listen to the individual sounds in sequence, to blend these to form a word (a form of auditory closure), and after discriminating among the pictures, to select the one identified by the word he has formed by the blending of the sounds. Auditory Memory measures the child's ability to retain and reproduce in words the ideas which he has heard. On this test,

the correct sound discrimination and sequence of sounds which are the basis of the words (and thereby the ideas) are not measured as such, but they facilitate the retention of the particular ideas contained in the story. The great memory burden imposed upon the child in the test of Auditory Memory, as compared to the other two subtests, may be responsible for the very low correlations with the other auditory tests. Evidently, at least three discrete auditory abilities are measured by the subtests of the Monroe Auditory Aptitude and although success in one or more of these may facilitate performance on the other, it does not guarantee success.

The very low correlations of the Monroe Word Discrimination and Sequence with the Wepman Auditory Discrimination Test suggests that very different abilities may have been measured by these tests. This suggestion is further supported when the four-fold task--(1) visual discrimination, (2) auditory discrimination, (3) memory for sequence, and (4) sound-symbol association--required of the child on the former test is compared with the single task--that of auditory discrimination to determine whether the word-pairs are similar or different--in the latter test. Seemingly, one (or more) of the other three tasks required in the Monroe Word Discrimination and Sequence test was more important to success on the

[illegible]

[illegible]

test than was auditory discrimination. Because of the low relationship of this test with the other two Monroe subtests, both of which involved memory for sequence, the significance of the visual factors was investigated by comparing the correlations of this test with some visual tests (Table XI). As demonstrated in Table XI, the correlations of Word Discrimination and Sequence with these selected visual tests were, with one exception--the boys' Visual Aptitude Total--significant at well beyond the .05 level of confidence for total group and for boys and girls separately. There seems little doubt that success on this test was much more closely related to success in visual discrimination than it was to auditory discrimination. Hence its low correlation with the Wepman Auditory Discrimination and the other auditory tests.

Learning Methods Test--Auditory Method. The auditory subtests of Immediate and Delayed Recall for the Learning Methods Test correlated significantly, beyond the .001 level of confidence for the entire group and for boys and girls separately (Tables VIII, IX, and X--I and J). The correlations for the boys, .74, were somewhat below those of the girls, .85. Mean differences for both subtests favored the boys but not significantly so (Table VII).

TABLE XI

CORRELATION OF MONROE WORD DISCRIMINATION AND SEQUENCE WITH SELECTED TESTS

Tests Correlated with Monroe Word Discrimination and Sequence	Total N=62	Boys N=31	Girls N=31
Pintner-Cunningham Dot Drawing	.42	.48	.35
Monroe Visual Aptitude Total	.33	.30	.36
Monroe Visual-Auditory-Motor Aptitude Total	.46	.45	.45
Visual Discrimination Test Pattern Copying	.49	.55	.44
Visual Discrimination Test - Part I - Letters and Words	.51	.61	.41
Visual Discrimination Test - Grand Total	.49	.60	.38

Significant at .01 level
Significant at .05 level

The relationship of the subtests of the Learning Methods Test to the other auditory tests has already been discussed in the previous subsections and will not be repeated here except to note the significant relationship with the Wepman Auditory Discrimination Test.

Summary. Four of the seven auditory tests for the total group and three for the boys were significantly related to measured intelligence. However, for the girls, the two subtests of the Learning Methods Test were the only auditory tests that correlated with intelligence quotient at the accepted five percent level of significance and the correlations of these tests with mental age were non-significant. Observed differences in means favored the girls on five out of the seven tests with the differences on the tests of Sound Blending and Auditory Aptitude Total reaching statistical significance at the accepted five percent level. On both tests of recall for the Learning Methods Test (Auditory Method) the boys' means were higher than those of the girls but the differences were non-significant. The Wepman Auditory Discrimination Test was the only auditory test which correlated significantly with performance on the Learning Methods Test. (In fact, it was demonstrated that one of the auditory tests, the Monroe Word Discrimination and

Sequence, correlated much more closely with a number of the visual discrimination tests than it did with the auditory tests.) Evidently, for the boys and girls in this sample, the ability to discriminate between similarities and differences in sounds was a prerequisite to success, in learning to recognize words by an auditory or phonic method.

Kinaesthetic-Motor Tests

Comparison of means for the boys and girls. The data in Table XII regarding the comparison of means for the boys and girls on the kinaesthetic-motor tests show that six of the nine observed differences favored the girls, and that two of these differences were significant beyond the .05 level of confidence. The girls' mean on the Monroe test of Motor Speed (2a--G, and I) was significantly higher than that of the boys. The critical ratio of $\pm$ 2.14 was significant at the .05 level of confidence. Mean differences on the Monroe Motor Aptitude Total (2d--G, and I) also favored the girls with a critical ratio of $\pm$ 2.20 which was significant at the .05 level of confidence. The identical means for the boys and girls on the Monroe test of Writing Name indicates approximately equal proficiency on this visual-motor task (2c--G). On the Monroe test of Motor Steadiness and the test of Pattern Completion from the Visual Discrimination Tests the mean

TABLE XII

COMPARISON OF KINAESTHETIC-MOTOR TEST RESULTS

Number of Pupils Boys: 31 Girls: 31 Total: 62

Kinaesthetic-Motor Tests	Means			Standard Deviations			Comparison of Means for Boys and Girls		
Name of Test	Total	Boys	Girls	Total	Boys	Girls	Observed Differences	Standard Error of Differences	Critical Ratio
	A	B	C	D	E	F	G	H	I
1. Pintner-Cunningham Dot Drawing	5.3	5.2	5.5	1.6	1.6	1.6	.3	.40	±.75
2. Monroe Reading Aptitude:									
a) Motor Speed	47.7	44.2	51.2	13.2	11.7	13.9	7.0	3.27	±2.14*
b) Motor Steadiness	9.6	9.7	9.4	3.3	3.4	3.2	.3	.85	±.35
c) Writing Name	4.0	4.0	4.0	.7	.6	.7	.0	.17	±.00
d) Motor Aptitude Total	61.8	57.9	65.6	14.2	12.1	15.3	7.7	3.50	±2.20*
3. Visual Discrimination:									
a) Pattern Copying	53.4	52.9	54.0	10.6	11.7	9.5	1.1	2.71	±.41
b) Pattern Completion	32.1	32.4	31.8	8.5	10.4	6.2	.6	2.17	±.27
4. Learning Methods Test									
a) Immediate Recall - Kinaesthetic	5.3	5.0	5.7	2.8	2.5	3.0	.7	2.85	±.24
b) Delayed Recall - Kinaesthetic	3.9	3.4	4.4	2.8	2.6	3.0	1.0	.72	±1.39

*Significant at .05 level of confidence

differences favored the boys, but the differences were not significant.

Most of the observed differences and all of the significant differences have favored the girls on the visual, auditory, and kinaesthetic-motor tests examined previously. In view of this fact, it is interesting to note the comparison of means for the boys and girls on the subtests of Pattern Copying and Pattern Completion from the Visual Discrimination Tests. The observed differences in means favored the girls on the test of Pattern Copying. On the Pattern Completion which is very similar to the Pattern Copying, but involves considerably less visual perceptual judgement of size and placement, the non-significant differences favored the boys. It would appear that when the visual-motor task was confined within the limits of a main figure or guided by a partial pattern, the boys were able to perform as well as, or slightly better than, the girls. However, on the Pattern Completion from the Pintner-Cunningham Primary the significant differences favored the girls at the .05 level of confidence. The major difference in the two tests of Pattern Completion was in the speed of discrimination involved in the subtest from the Pintner-Cunningham. Apparently the girls in the sample were better able to cope with this difference than were the boys.

<u>Intelligence and kinaesthetic-motor tests</u>. The intercorrelations of intelligence and the kinaesthetic-motor tests for the total group are presented in Table XIII. Seven out of the nine kinaesthetic-motor tests revealed significant correlations with both mental age and intelligence quotient (2 and 3, D to L) and all of these seven except the <u>Monroe Reading Aptitude</u>--Motor Aptitude Total were significant beyond the .01 level of confidence for the total group. The Monroe tests of Motor Steadiness and Writing Name showed either a negative or negligible relationship with intelligence. It may well be that the abilities measured on these last two tests are more closely related to experience, which in turn may have been influenced by such factors as the presence of older siblings, parental interest, or kindergarten training.

Tables XIV and XV reveal that there was a significant relationship between mental age and intelligence quotient and scores on seven out of the nine tests for the boys. However, for the girls, only three auditory tests correlated significantly with mental age and four with intelligence quotient. The four tests which showed a high correlation with intelligence for boys but low or indifferent correlations with intelligence for girls were: <u>Monroe Reading Aptitude</u>--Motor Speed and Motor Aptitude

TABLE XIII

INTERCORRELATION OF INTELLIGENCE AND KINAESTHETIC-MOTOR TESTS

FOR THE TOTAL GROUP

N = 62

Tests Correlated	Chronological Age	P-C. P. M.A.	P-C. P. I.Q.	P-C. P. Dot Drawing	M.R.A.P. Motor Speed	M.R.A.P. Motor Stead.	M.R.A.P. Writing Name	M.R.A.P. Motor Apt.	V.D. Pattern Copying	V.D. Pattern Comp.	L.M.T. Kin. Imm. Rec.	L.M.T. Kin. Del. Rec.
	A	B	C	D	E	F	G	H	I	J	K	L
1. Chronological Age		.15	-.13	.07	.04	-.18	-.15	-.06	-.15	-.29	-.20	-.15
2. Pintner-Cunningham Primary Mental Age			.95	.62	.35	-.02	.17	.30	.44	.39	.34	.36
3. Pintner-Cunningham Primary Intelligence Quotient				.61	.36	.05	.24	.29	.49	.49	.41	.42
4. Pintner-Cunningham Primary Dot Drawing					.36	.16	.23	.37	.58	.58	.23	.32
5. Monroe Reading Aptitude Primary Motor Speed						.03	.18	.93	.05	.16	.19	.24
6. Monroe Reading Aptitude Primary Motor Steadiness							.08	.28	.36	.24	-.06	-.03
7. Monroe Reading Aptitude Primary Writing Name								.18	.34	.35	.36	.40
8. Monroe Reading Aptitude Primary Motor Aptitude Total									.15	.18	.14	.22
9. Visual Discrimination Test I Pattern Copying										.71	.31	.42
10. Visual Discrimination Test I Pattern Completion											.21	.32
11. Learning Methods Test Kinaesthetic Immediate Recall												.83

Significant at the .01 level

Significant at the .05 level

TABLE XIV

INTERCORRELATION OF INTELLIGENCE AND KINAESTHETIC-MOTOR TESTS

FOR THE BOYS

N = 31

	Tests Correlated	Chronological Age	P-C. P. M.A.	P-C. P. I.Q.	P-C. P. Dot Drawing	M.R.A.P. Motor Speed	M.R.A.P. Motor Stead.	M.R.A.P. Writing Name	M.R.A.P. Motor Apt.	V.D. Pattern Copying	V.D. Pattern Comp.	L.M.T. Kin. Imm. Rec.	L.M.T. Kin. Del. Rec.
		A	B	C	D	E	F	G	H	I	J	K	L
1.	Chronological Age		.18	-.03	.21	.09	-.21	-.14	.02	-.05	-.22	-.08	-.12
2.	Pintner-Cunningham Primary Mental Age			.97	.64	.46	.03	.21	.46	.47	.39	.43	.40
3.	Pintner-Cunningham Primary Intelligence Quotient				.61	.43	.11	.29	.46	.51	.45	.46	.44
4.	Pintner-Cunningham Primary Dot Drawing					.45	.23	.30	.51	.57	.58	.41	.41
5.	Monroe Reading Aptitude Primary Motor Speed						-.03	.04	.96	.00	.12	.21	.20
6.	Monroe Reading Aptitude Primary Motor Steadiness							-.04	.25	.43	.29	-.12	-.23
7.	Monroe Reading Aptitude Primary Writing Name								.07	.27	.30	.41	.33
8.	Monroe Reading Aptitude Primary Motor Aptitude Total									.13	.22	.19	.15
9.	Visual Discrimination Test I Pattern Copying										.73	.33	.38
10.	Visual Discrimination Test I Pattern Completion											.21	.34
11.	Learning Methods Test Kinaesthetic Immediate Recall												.83

Significant at the .01 level

Significant at the .05 level

TABLE XV

INTERCORRELATION OF INTELLIGENCE AND KINAESTHETIC-MOTOR TESTS FOR THE GIRLS

N = 31

Tests Correlated	Chronological Age	P-C. P. M.A.	P-C. P. I.Q.	P-C. P. Dot Drawing	M.R.A.P. Motor Speed	M.R.A.P. Motor Stead.	M.R.A.P. Writing Name	M.R.A.P. Motor Apt.	V.D. Pattern Copying	V.D. Pattern Comp.	L.M.T. Kin. Imm. Rec.	L.M.T. Kin. Del. Rec.
	A	B	C	D	E	F	G	H	I	J	K	L
1. Chronological Age		-.01	-.37	-.13	-.18	-.15	-.16	-.09	-.33	-.44	-.41	-.38
2. Pintner-Cunningham Primary Mental Age			.92	.60	.19	-.10	.16	.06	.37	.45	.22	.18
3. Pintner-Cunningham Primary Intelligence Quotient				.62	.28	-.03	.20	.12	.46	.59	.36	.32
4. Pintner-Cunningham Primary Dot Drawing					.27	.10	.18	.23	.60	.64	.06	.13
5. Monroe Reading Aptitude Primary Motor Speed						.11	.30	.90	.07	.29	.13	.18
6. Monroe Reading Aptitude Primary Motor Steadiness							.18	.36	.29	.17	-.01	.03
7. Monroe Reading Aptitude Primary Writing Name								.27	.44	.17	.33	.36
8. Monroe Reading Aptitude Primary Motor Aptitude Total									.15	.21	.05	.15
9. Visual Discrimination Test I Pattern Copying										.71	.30	.38
10. Visual Discrimination Test I Pattern Completion											.25	.25
11. Learning Methods Test Kinaesthetic Immediate Recall												.84

Significant at the .01 level
Significant at the .05 level

Total, and both Kinaesthetic Immediate Recall and Kinaesthetic Delayed Recall of the Learning Methods Test. Compared to the boys in the sample, the girls were significantly older. The girls attained: (1) higher means in intelligence quotient and mental age, although the differences were non-significant (Table I, page 49), (2) significantly higher means on Monroe tests of Motor Speed and Motor Aptitude Total (Table XII--2a I and 2d I, page 134), and (3) higher mean scores on the tests of Immediate and Delayed Recall of the Learning Methods Test --Kinaesthetic Method (although again the differences failed to reach a level of statistical significance). The combined effect of a chronological age advantage, a tendency of girls to mature earlier, and a tendency of girls to engage in more pre-school activities which contribute to the development of visual-motor skills, has possibly masked the relationship of intelligence to performance on the kinaesthetic-motor tests. The girls' pre-school experiences often allow for more small-muscle activities such as sewing, coloring, and cutting. These experiences may have contributed more than did intelligence toward successful performance on the tests of Motor Speed (a test of the subject's ability to place a small pencil dot in as many as possible of the small circles within a sixty-second time limit) and Motor Aptitude Total.

trial) and both kindergarten [illegible] and kinesthetic [illegible] of the [illegible] [illegible]. [illegible] were significantly [illegible]. The [illegible] seems to [illegible] the differences were [illegible] (1) slightly [illegible] [illegible] pair [illegible] and (2) [illegible] conditions [illegible] [illegible] failed to [illegible] The [illegible] tendency to [illegible] children in the development of [illegible] [illegible] to the [illegible] [illegible] experience [illegible] [illegible] found to [illegible] within a [illegible]

Perhaps, even the girls of lower intelligence, with their more mature muscular co-ordination, were able to concentrate a higher degree of their intellectual capacities upon the sound and written form of the words in the *Learning Methods Test*--Kinaesthetic Method than were their male counterparts whose attention may have been concentrated on the motor task *per se*.

Interrelationship of the kinaesthetic-motor tests. Tables XIII, XIV, and XV on pages 137, 138, and 139 present the intercorrelations of the nine kinaesthetic-motor test scores for the total group, boys, and girls respectively. The interrelationship of these tests will be discussed under the headings of the four main tests involved.

Pintner-Cunningham Primary--Dot Drawing. The total group performance on the test of Dot Drawing correlated significantly at the .01 level of confidence with five of the other eight kinaesthetic-motor tests (Table XIII, 4--E to L). The three tests with which it failed to show any appreciable relationship for the total group were those of Motor Steadiness, Writing Name, and the Kinaesthetic Immediate Recall (*Learning Methods Test*).

The boys' performance on the test of Dot Drawing correlated significantly, at or above the accepted five

percent level, with six of the other eight tests (Table XIV, 4--E to L). The tests failing to correlate significantly with this test for the boys were those of Motor Steadiness and Writing Name--subtests of the Monroe Reading Aptitude. On the other hand, the girls' performances in Dot Drawing correlated significantly with only two of the other tests, those of the Visual Discrimination Tests --Pattern Copying, .60, and Pattern Completion, .64. Apparently the girls' performance in Dot Drawing bore little relationship to the tests which required, for the most part, visual-motor co-ordination but it was closely related to the tests which required more purely visual perceptual skills. However, the boys' performance on this test was closely related to tests of both motor and visual perceptual skills.

Monroe Reading Aptitude--Motor Aptitude. The Monroe test of Motor Speed which is designed to measure speed of reaction and muscular co-ordination showed a consistent and very high correlation (significant well beyond the .01 level of confidence) with the Monroe Motor Aptitude Total for the total group, .93, for the boys, .96, and for the girls, .90. The only other test with which it correlated significantly was that of Dot Drawing for the total group, .36, and for the boys, .45 (Tables

[illegible]

[illegible]

Apparently [illegible]

[illegible]

[illegible]

XIII, XIV, and XV, 5--D to L).

The Monroe test of Motor Steadiness which is designed to measure eye-hand muscular co-ordination correlated significantly with two of the other tests for total group, boys, and girls. It showed a significant relationship with the Monroe Motor Aptitude Total for the total group, .28, and for the girls, .36. It also showed a significant relationship with the test of Pattern Copying from the *Visual Discrimination Tests* for the total group, .36, and for the boys, .43.

For the total group the Monroe test of Writing Name correlated significantly, at the .01 level of confidence, with the tests of Pattern Copying, .34, and Pattern Completion, .35, from the *Visual Discrimination Tests*, and with the Kinaesthetic Immediate Recall, .36, and Kinaesthetic Delayed Recall, .40, of the *Learning Methods Test*. For the boys (Table XIV, 7--D to L) it was significantly related to only one test, that of the Kinaesthetic Immediate Recall, .41, and for the girls (Table XV, 7--D to L) to two other tests, those of Pattern Copying from the *Visual Discrimination Tests*, .44, and Kinaesthetic Delayed Recall from the *Learning Methods Test*, .36. All of the tests, previously mentioned for the total group, showed a fairly high relationship to Writing Name for both sexes. Apparently the motor control

and visual memory (immediate or delayed) required by the child in writing his name, or in learning words by a tracing or kinaesthetic method, are abilities closely related to those required in observing and reproducing or completing geometric forms.

Tables XIII, XIV, and XV, pages 137, 138, and 139, indicate that performance on the Monroe Motor Aptitude Total was significantly related to three of the other tests for the total group, and to two tests for each sex separately. Its relationship to Dot Drawing was significant at the .05 level for the total group, .37, and for the boys, .51, but non-significant for the girls, .23. It correlated significantly and very highly with Motor Speed for the total group, .93, for the boys, .96, and for the girls, .90. Motor Aptitude Total also showed a significant relationship with Motor Steadiness for the total group, .28, and for the girls, .36, but a non-significant relationship with the latter test for the boys, .25. Its relationship with all of the other motor tests was negligible. It would appear that the eye-hand co-ordination required on the tests of Dot Drawing, Motor Speed, and Motor Steadiness is a very important component of this composite measure of motor ability, as evidenced by the significant correlations.

Visual Discrimination Tests (Form). The significant relationship of the test of Pattern Copying to the previously discussed kinaesthetic-motor tests has already been noted and will not be repeated here. A consistent and highly significant relationship between the two subtests of the Visual Discrimination Tests--Pattern Copying and Pattern Completion is shown for the total group, .71, for the boys, .73, and for the girls, .71. With the test of Kinaesthetic Immediate Recall from the Learning Methods Test, Pattern Copying showed significant relationship for the total group, .31, but was slightly below the accepted significance levels for the boys, .33 and for the girls, .30. It was significantly related to performance on the Kinaesthetic Delayed Recall for the entire group, .42, for the boys, .38, and for the girls, .38. In all then, the test of Pattern Copying showed a significant correlation with six of the other eight kinaesthetic-motor tests for the total group, and with four of the eight tests for boys and girls separately.

Performance on the test of Pattern Completion was significantly correlated with five out of the eight other kinaesthetic-motor tests for the total group, and with two for the boys and girls separately. For the total group the results in Pattern Completion were significantly related to Dot Drawing, .58, Writing Name, .35, Pattern

Copying, .71, and to the Kinaesthetic Immediate Recall, .31 and Kinaesthetic Delayed Recall, .42 of the Learning Methods Test. When comparison was made of boys' and girls' results the same two for each sex were significantly related to Pattern Completion. The two tests were Dot Drawing, .58 and .64, and Pattern Copying, .73 and .71, for boys and girls respectively.

Learning Methods Test--Kinaesthetic Method. The test results of Kinaesthetic Immediate Recall were significantly related to three of the eight other kinaesthetic-motor tests for the total group and for boys, but to only one test for the girls. Kinaesthetic Immediate Recall correlated significantly with Writing Name for both total group, .36, and boys, .41, with Pattern Copying, .31, for the total group, and with Dot Drawing, .41, for the boys. A highly significant and consistent correlation was shown for the total group, .83, for the boys, .83, and for the girls, .48, on the two recall tests of the Kinaesthetic Method.

The test results on the test of Delayed Recall by the Kinaesthetic Method correlated significantly with five of the eight other tests for the total group, and three for the boys and girls separately. For the total group, the test correlated significantly with Dot Drawing,

.32, Writing Name, .40, Pattern Copying, .42, Pattern Completion, .32, and Immediate Recall, .83. Boys' and girls' performances on this test showed significant and almost identical correlations with Immediate Recall and with Pattern Copying. The boys' results showed a significant relationship with Dot Drawing although the relationship between these two tests for the girls was negligible. The correlation of this test with Writing Name failed to reach significance level for the boys, .33, but it was significant at the .05 level for the girls, .36.

It appears that success in learning to recognize and recall words by the Kinaesthetic Method (as adapted for this study) is most closely related to success in Dot Drawing for boys, and to Writing Name, Pattern Copying, and Pattern Completion for both boys and girls. This suggests that the visual perceptual abilities of position in space, positional relationships between points of reference, figure-ground perception, size judgement, and visual-motor co-ordination are at least as important as, if not more important than, the kinaesthetic or motor components of the method.

<u>Summary</u>. As in the tests of auditory and visual abilities, the boys' performances on the kinaesthetic-

(b) Writing Test, (c) [illegible] (d) [illegible] Comprehension, [illegible] global performance [illegible] [illegible] The correlation of this [illegible] significance [illegible] girls, [illegible]

It appears that [illegible] are [illegible] for this study [illegible] The [illegible] and [illegible] suggests that the [illegible] in space, [illegible] if not more important than [illegible] components of the [illegible].

Summary. [illegible]

motor tests were much more closely related to their level of measured intelligence than were those of the girls. However, for the total group there was a high relationship between all of the kinaesthetic-motor tests and intelligence, except the two Monroe subtests of Writing Name and Motor Steadiness. The performance of the girls on the kinaesthetic-motor tests was superior to that of the boys on six out of the nine tests, and significantly so on the tests of Motor Speed and Motor Aptitude Total. Learning to recognize words by the Kinaesthetic Method of the _Learning Methods Test_ correlated significantly with Dot Drawing for the boys, and with Pattern Copying and Writing Name for both boys and girls. There is some suggestion that the girls were better able to perform the motor part of the visual-motor task and thus could concentrate more of their attention on the visual perceptual components, whereas the boys' attention had to be focussed on both the visual and motor components of the task.

Combination Tests

Comparison of means for the boys and girls. A comparison of the boys' and girls' means on the Combination Tests recorded in Table XVI shows that the observed differences favored the girls on three out of the four

TABLE XVI

COMPARISON OF COMBINATION METHOD TEST RESULTS

Number of Pupils Boys: 31 Girls: 31 Total: 62

Combination Tests Name of Test	Means Total	 Boys	 Girls	Standard Deviations Total	 Boys	 Girls	Comparison of Means for Boys and Girls Observed Differences	 Standard Error of Differences	 Critical Ratio
	A	B	C	D	E	F	G	H	I
1. Monroe Reading Aptitude:									
a) Visual-Auditory Motor Aptitude Total	115.4	110.1	120.8	18.4	16.1	19.4	10.7	4.51	±2.39*
b) Reading Aptitude Total Score	227.9	221.6	234.2	28.3	26.9	28.6	12.6	7.06	±1.78
2. Learning Methods Test:									
a) Immediate Recall - Combination	5.7	5.9	5.6	2.7	2.6	2.9	.3	.70	±.41
b) Delayed Recall - Combination	4.1	4.0	4.2	2.7	2.5	3.0	.2	.23	±.69

*Significant at .05 level of confidence

tests--the Visual-Auditory-Motor Total and the Reading Aptitude Total of the Monroe Reading Aptitude Tests and the Combination Delayed Recall of the Learning Methods Test. On the first of these, the Monroe Visual-Auditory-Motor Total, the critical ratio of $\pm$ 2.39 was significant at the .02 level of confidence. The observed difference favored the boys on the Combination Immediate Recall test of the Learning Methods Test, but the ratio was non-significant.

Intelligence and the combination tests. Reference to Table XVII shows that three out of the four combination test scores showed statistically significant relationships with intelligence for the total group. The fourth test, the test of Delayed Recall for the Learning Methods Test--Combination Method, fell short of the .05 level of significance with mental age but showed a correlation with intelligence quotient, .34, that was significant beyond the .05 level of confidence.

Comparisons of the boys' and girls' performances on these tests (Tables XVIII and XIX) reveal some interesting differences. Both the Monroe Reading Aptitude subtests--Visual-Auditory-Motor Total and Reading Aptitude Total Score--showed correlations that were significant at well beyond the .01 level of confidence with both

TABLE XVII

INTERCORRELATION OF INTELLIGENCE AND COMBINATION METHOD TESTS

FOR THE TOTAL GROUP

N = 62 Tests Correlated	Chronological Age A	P-C. P. M.A. B	P-C. P. I.Q. C	M.R.A.P. Vis.-Aud.-Mot. Total D	M.R.A.P. Total Score E	L.M.T. Comb. Imm. Recall F	L.M.T. Comb. Del. Rec. G
1. Chronological Age		.15	-.13	.09	.09	-.25	-.16
2. Pintner-Cunningham Primary Mental Age			.95	.38	.44	.26	.22
3. Pintner-Cunningham Primary Intelligence Quotient				.37	.42	.34	.28
4. Monroe Reading Aptitude Primary Visual-Auditory-Motor Total					.89	.10	.14
5. Monroe Reading Aptitude Primary Total Score						.24	.21
6. Learning Methods Test Combination Method-Immediate Recall							.80

Significant at .01 level
Significant at .05 level

TABLE XVIII

INTERCORRELATION OF INTELLIGENCE AND COMBINATION METHOD TESTS

FOR THE BOYS

N = 31 Tests Correlated	Chronological Age	P-C. P. M.A.	P-C. P. I.Q.	M.R.A.P. Vis.-Aud.-Mot. Total	M.R.A.P. Total Score	L.M.T. Comb. Imm. Recall	L.M.T. Comb. Del. Rec.
	A	B	C	D	E	F	G
1. Chronological Age		.18	-.03	.10	.23	-.12	.04
2. Pintner-Cunningham Primary Mental Age			.97	.58	.62	.32	.24
3. Pintner-Cunningham Primary Intelligence Quotient				.57	.57	.37	.24
4. Monroe Reading Aptitude Primary Visual-Auditory-Motor Total					.88	.10	.06
5. Monroe Reading Aptitude Primary Total Score						.21	.09
6. Learning Methods Test Combination Method-Immediate Recall							.80

Significant at .01 level ____ (red)
Significant at .05 level ____ (green)

TABLE XIX

INTERCORRELATION OF INTELLIGENCE AND COMBINATION METHOD TESTS

FOR THE GIRLS

N = 31

Tests Correlated	Chronological Age	P-C. P. M.A.	P-C. P. I.Q.	M.R.A.P. Vis.-Aud.-Mot. Total	M.R.A.P. Total Score	L.M.T. Comb. Imm. Recall	L.M.T. Comb. Del. Rec.
	A	B	C	D	E	F	G
1. Chronological Age		.11	-.38	-.12	-.19	-.38	-.38
2. Pintner-Cunningham Primary Mental Age			.92	.11	.15	.23	.23
3. Pintner-Cunningham Primary Intelligence Quotient				.16	.23	.36	.35
4. Monroe Reading Aptitude Primary Visual-Auditory-Motor Total					.90	.14	.18
5. Monroe Reading Aptitude Primary Total Score						.31	.31
6. Learning Methods Test Combination Method-Immediate Recall							.80

Significant at .01 level

Significant at .05 level

mental age, .58 and .62, and intelligence quotient, .57 and .57, for boys, while these same tests for the girls indicated a negligible relationship with intelligence. Apparently any effects of differences in intelligence levels upon the girls' performance on these tests (which include subtests in Articulation and Language) have been masked by their advantage in chronological age and/or greater maturity.

Neither the Immediate nor Delayed Recall tests of the _Learning Methods Test_ correlated highly with mental age for either boys or girls. The girls' performance on both of these showed correlations that were barely significant at the .05 level of confidence with intelligence quotient, .36 and .35, and only the test of Immediate Recall reached the .05 level of significance with intelligence quotient, .37, for the boys. Again it would seem that the significant difference in chronological age, favoring the girls, had worked to their advantage on the combination method tests.

Interrelationship of the combination method tests. An overview of the intercorrelations of the combination method tests, given in Tables XVII, XVIII, and XIX, reveals that the significant relationships were all intra-test relationships. Thus the Monroe Visual-Auditory-Motor Total correlated significantly with the Monroe Reading Aptitude

Total for the entire group, .89, for the boys, .88, and for the girls, .90. In a similar pattern the Combination Immediate Recall correlated significantly with the Combination Delayed Recall of the Learning Methods Test and these correlations, .80, were identical for total group, and boys and girls separately. The inter-test relationship of the subtests of the Monroe Reading Aptitude Primary and the Combination Method of the Learning Methods Test failed to reach statistical significance.

Although the Visual-Auditory-Motor Total showed negligible correlations with either recall test of the Learning Methods Test (Combination Method), the Reading Aptitude Total approached the accepted five percent significance level with both recall tests for the boys, and in the girls' correlations it was very close to statistical significance. Evidently the total score on the Monroe Reading Aptitude is, comparatively, a more similar measure of the abilities required in the Combination Method of learning to recognize words than is the grand total of the subtests designated as Visual, Auditory, and Motor. Included in the Reading Aptitude Total are two tests of Articulation--Reproduction and Speed--and three tests of Language--Vocabulary, Classification, and Sentence Length--as well as the subtests of visual, auditory, and motor aptitude. It seems reasonable that the child with greater

facility in language will be better equipped to utilize a multi-sensory approach in learning to recognize words (with particular emphasis on the visual, auditory, and kinaesthetic avenues of learning). The high relationship between language development and learning to read has been well documented by many authors. The relationship of perceptual development in the visual, auditory, and kinaesthetic-motor areas to total language development has been highlighted by the recent investigations of a team of workers at the Institute For Research on Exceptional Children at Urbana, Illinois. Notable examples of the work which has emphasized this relationship have been that of Kirk and McCarthy with the *Illinois Test of Psycholinguistic Abilities* (1963) and that of Bateman in the diagnosis and remediation of learning disabilities (1964). If perceptual development in the areas mentioned above is a prerequisite to language development, it should follow that facility in language should be accompanied by the ability to utilize learning cues from each of these sensory pathways (not necessarily with equal competence in each perceptual area).

Summary. There was a significant relationship between scores on the combination tests and measured intelligence for the total group, but girls tended to

have fewer significant correlations and the correlations were generally lower than those of the boys. As in the test results for the visual, auditory, and kinaesthetic-motor tests, the superiority of the girls' performance was borne out in the combination test results. Three of the four differences in means favored the girls and on the Monroe Visual-Auditory-Motor Total the difference reached statistical signficance at the .02 level of confidence. The only significant relationships revealed in the intercorrelations were intra-test relationships--that is, between the subtests of the Monroe Reading Aptitude Primary Tests and between the subtests of the Learning Methods Test. The Monroe Reading Aptitude total score which included two subtests of articulation and three tests of language ability correlated more closely with the subtests of the Learning Methods Test than did the grand total of the visual, auditory, and motor subtests of the Monroe Reading Aptitude. This suggests the importance of the children's language ability in learning to recognize words by a combination method which utilizes learning cues from several sensory pathways.

IV. SUMMARY OF TEST RESULTS

The test of mental ability showed that the boys and girls in the sample were approximately equal in intelligence

been found significantly [illegible]
with generally [illegible]
test results [illegible]
[illegible]
[illegible]
the [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible] between the subtests of the [illegible]
[illegible] and between the subtests of the [illegible]
[illegible]
which [illegible]
of [illegible]
[illegible]
of the [illegible]
[illegible]
children's [illegible]
[illegible]
[illegible]

[illegible]

The [illegible]
[illegible]

although the boys were significantly more variable in mental age. The girls were significantly older in chronological age.

The observed differences favored the girls on nine visual, five auditory, six kinaesthetic-motor, and three combination tests while the differences favored the boys on three visual, two auditory, two kinaesthetic-motor, and one combination test. The boys and girls obtained identical means on the visual tests of Form Total from the _Visual Discrimination Tests_ and Writing Name from the _Monroe Reading Aptitude_. All of the significant differences in means favored the girls. The girls' means were significantly higher on the _Pintner-Cunningham Primary_ subtest of Picture Completion and on the _Monroe Reading Aptitude_ auditory subtests of Sound Blending and Auditory Aptitude Total, motor subtests of Motor Speed and Motor Aptitude Total, and the Visual-Auditory-Motor Aptitude Total.

The majority of the visual, auditory, kinaesthetic-motor, and combination tests were significantly correlated with intelligence for total group and for the boys. For the girls, fewer tests correlated significantly with this variable and on the average the correlations were lower than those of the boys.

Correlations between chronological age and the test

results were, for the most part, either negligible or negative and it correlated significantly with only three out of the thirty-three tests for the total group and for the boys. The relationship between chronological age and the test results for the girls was particularly low.

The immediate and delayed recall tests of the *Learning Methods Test* attained a significant level of correlation with relatively few of the other tests designed to measure the same type of sensory learning. The test of Immediate Recall for the Visual Method was significantly related to the Letters and Words Total and the Grand Total of the *Visual Discrimination Tests* for the total group and boys, to the Dot Drawing from the *Pintner-Cunningham Primary* for the total group and boys, and to the Form Memory and Visual Aptitude Total from the *Monroe Reading Aptitude* for girls. The Delayed Recall for the Visual Method related significantly to Letters and Words Total and the Grand Total of the *Visual Discrimination Tests* for the total group and girls, to Visual Aptitude Total for the girls only, and to none of the other visual tests for the boys. The only significant relationships between the recall tests for the Auditory Method and other auditory tests were with the *Wepman Auditory Discrimination Test*. The Immediate Recall test for the Kinaesthetic Method correlated significantly with Writing Name

from the Monroe Reading Aptitude for total group and boys, with Dot Drawing from the Pintner-Cunningham Primary for boys only, and to none of the other kinaesthetic-motor tests for the girls. The test of Delayed Recall for the Kinaesthetic Method showed significant correlations with Pattern Copying for the total group, with Dot Drawing for total group and boys, and with Writing Name for girls. Neither of the recall tests for the Combination Method reached a significant level of correlation with the other combination tests.

V. INTERPRETATION OF THE ANALYSES OF VARIANCE

Sex versus Methods--Analysis of Variance I (N=62)

This two-by-four analysis of variance was designed to test the hypothesis of no significant relationship between sex and learning to recognize words by any of the four methods of the Learning Methods Test. Because there were equal numbers of each sex and each child was taught by each of the four methods, the experiment was modelled after that of Winer for a repeated measures design with equal cell frequencies (1962, p. 307).

The four levels of factor B--the treatment variable --were the four methods of the Learning Methods Test. The levels were designated as:

b_1 -- Visual Method

b_2 -- Auditory Method

b_3 -- Kinaesthetic Method

b_4 -- Combination Method

The two levels of factor A--the classification variable--were the sexes and they were designated as:

a_1 -- Males (n=31)

a_2 -- Females (n=31)

The criterion or dependent variable was the child's Delayed Recall score for each method. The data were tested by an analysis of variance. A summary of the analysis is recorded in Table XX.

Reference to the fifth column of Table XX shows that the F-ratio for interaction between sex and methods was significant at the accepted five percent level of confidence. This is an indication that none of the treatments (methods) was uniformly superior or inferior with both of the sexes, but rather that one or more of the methods was superior for one of the sexes. Because a significant interaction was found, a test on simple main effects was called for.

The tests on the simple main effects of factor A (sex) at the four levels of factor B (methods) gave no reason to reject the hypothesis of no significant difference in the effects of factor A (sex) when all observations were made at any <u>one</u> level of b (methods). Thus

b_2 — [illegible] Ranked

b_3 — [illegible] Ranked

b_4 — [illegible] Ranked

The two levels of factor A—the [illegible] [illegible] [illegible]—were designated as:

a_1 — [illegible] (1952)

a_2 — [illegible] (1961).

The [illegible] of dependent variable [illegible] [illegible] [illegible] [illegible] [illegible] for each [illegible]. The data were [illegible] by analysis of variance. A summary of the analysis is reported in Table 22.

Reference to the [illegible] [illegible] in Table 22 [illegible] that the F-ratio for [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] for [illegible] of the [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of the four levels of factor B [illegible] [illegible] [illegible] to [illegible] the hypothesis [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of factor A [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. The

TABLE XX

SUMMARY TABLE FOR ANALYSIS OF VARIANCE

SEX VERSUS METHODS

Source of Variation	Sums of squares	Degrees of Freedom	Mean-squares	F-ratio
Between Subjects	1423.60	61		
A (Sex)	0	1	0	0
Subjects within groups	1423.60	60	23.72	
Within Subjects	673.5	186		
B (Methods)	23.77	3	7.92	2.30
AB (Interaction)	29.91	3	9.97	2.89*
Bx Subjects within groups	619.82	180	3.44	

*Significant at .05 level.

neither sex was significantly superior to the other in learning by any one method.

The tests on the simple main effects of factor B (methods) showed that when all observations were made at level a_1 (males) the resulting F-ratio was significant beyond the one percent level of confidence. Hence the test tended to reject the null hypothesis of no significant relationship between the male sex and learning to recognize words by one of the four methods. To determine which method (or methods) was superior for the boys, the Newman-Keuls procedure for testing differences between all possible pairs of means was used. The Newman-Keuls procedure, described in Winer (1962, section 3.8) involves the use of the truncated studentized range statistic with ordered means. The tests on the means are summarized in Table XXI.

In Table XXI the means for the methods have been arranged in ascending order of size from left to right, with the kinaesthetic appearing first, followed by the combination, auditory, and visual. The first section shows the differences between all possible pairs of means, the second section shows the critical level of the differences, and the third section shows that the only pairs of means that can be considered different are b_1 and b_2--the means for the Auditory and Visual Method.

neither one was significantly superior to the other in learning by age and method.

The tests on the simple main effects of Factor B (methods) showed that when all observations were made at level a_1 (white) the resulting F-ratio was significant beyond the one percent level of confidence. Hence the test tended to reject the null hypothesis of no significant relationship between the ability to recognize words by one of the four methods. To determine which method (or methods) was superior for the task, the Newman-Keuls procedure for testing differences between all possible pairs of means was used. The Newman-Keuls procedure, described in Winer (1962, pp. 80–85) involves the use of the studentized range statistic with ordered means. The tests on the means are summarized in Table XII.

In Table XII the means for the methods have been arranged in ascending order of size from left to right, with the kinesthetic-tactile method first, followed by the combination, auditory, and visual. The first section shows the differences between all possible pairs of means, the second section shows the critical values of these differences, and the third section shows those two pairs of means that can be considered different: b_1 and b_4—the means for the kinesthetic and visual methods

TABLE XXI

TESTS ON MEANS OF FOUR LEARNING METHODS

FOR BOYS

Methods	b_3	b_4	b_2	b_1
Ordered Means	3.39	4.00	4.81	4.97

(i)		b_3	b_4	b_2	b_1
	b_3	——	.61	1.42	1.58
	b_4		——	.81	.97
Differences between pairs	b_2				.16

	$s_{\bar{B}} = .23$	$r =$	2	3	4
(ii)	$q_{.95}(r,180)$		2.77	3.31	3.63
	$s_{\bar{B}}q_{.95}(r,180)$		.64	.76	.83

(iii)		b_3	b_4	b_2	b_1
	b_3	——	——	* **	* **
	b_4			*	* **
	b_2				——

* Significant at .05 level
** Significant at .01 level

The mean performance on the Visual and Auditory Methods for boys was statistically different from the mean performance on the Kinaesthetic Method at the .01 level of confidence. The differences in the boys' means for the Auditory and Combination Methods and the Visual and Combination Methods were significant at the .05 and .01 levels respectively. Thus the Visual and Auditory Methods of the Learning Methods Test were superior to the other two methods for the boys in this sample and the null hypothesis is rejected.

Mental Age versus Methods--Analysis of Variance II (N=62)

This analysis was designed to test the relationship between mental age and learning to recognize words by the four methods of the Learning Methods Test. Because there were unequal numbers in each mental age grouping and each child was observed under each of the treatments, a repeated measures design for unequal cell frequencies was required. Therefore, the experiment was patterned after the three-factor model of Winer, a least-squares solution for a repeated measures design with unequal cell frequencies, adjusted to fit a two-way model (1962, p. 375).

The three levels of factor A--the classification variable--were selected by computing the upper and lower quartiles and the semi-interquartile range for the distri-

The mean performance on the Visual and Auditory Sections for each was statistically different from the mean performance on the Kinesthetic Method at the .01 level of significance. The differences in the mean scores for the Auditory and Combination Methods and the Visual and Combination Methods were significant at the .05 and .01 levels respectively. Thus the Visual and Auditory Sections of the *Learning Methods Test* were superior to the other two methods for the boys in this sample and the null hypothesis was rejected.

Mental Age versus Results—[illegible]

This analysis was designed to test the relationship between mental age and learning to recognize words by the four methods of the *Learning Methods Test*. Because there were unequal numbers in each mental age grouping and each child was observed under each of the four methods, a mixed [illegible] design for analysis with [illegible] was required. Therefore, the experimenter [illegible] the three-factor model of Winer, a [illegible] for a repeated measures design with [illegible] adjusted to fit a two-way model (1962, p. [illegible]).

The three levels of [illegible]—the [illegible] variable—were selected by [illegible] the upper and lower quartiles and the [illegible]

bution of mental ages. The result of this selection was three mental age levels or groupings of unequal size. The levels were designated:

a_1 -- High Group (ranging from 89 to 124 months)

a_2 -- Middle Group (ranging from 79 to 88 months)

a_3 -- Low Group (ranging from 64 to 78 months)

As in the first analysis the four levels of factor B, the treatment variable, were the four methods and the criterion variable was the child's Delayed Recall score for each method of the <u>Learning Methods Test</u>. The data were tested by analysis of variance and have been summarized in Table XXII.

The information recorded in the summary table of the analysis of variance shows that the F-ratio for factors B (methods) and AB (interaction of methods and mental age groupings) did not exceed the respective critical values required for significance. However, the F-ratio of 3.17 for factor A (mental age groupings) attained statistical significance. Hence the data do not support the hypothesis of no relationship between mental age and learning to recognize words by the four methods of the <u>Learning Methods Test</u>.

Because of the significant F-ratio for factor A (mental age groupings) a test of main effects was necessary to determine which level of factor A was significantly

subjects of mental ages. The result of this analysis was three mental age levels or groupings of subjects. The levels were designated:

b_1 — High Group (ranging from 90 to 135 months)

b_2 — Middle Group (ranging from 75 to 91 months)

b_3 — Low Group (ranging from 54 to 74 months)

It is the first analysis the four levels of Factor A, the treatment methods, were the four methods and the interaction variable was the child's mental [illegible] using the method of the Learning Methods Test. The data were treated by analysis of variance and have been summarized in Table XXII.

The information presented in the summary table of the analysis of variance shows that the F-ratio for Factor B (methods) and AB (interaction of methods and mental age groupings) did not exceed the respective critical values required for significance. However, the F-ratio for Factor A (mental age groupings) [illegible] attained significance. These [illegible] do not support the hypothesis of no relationship between mental age and learning [illegible] words by the four methods of the Learning Methods Test.

Because of the significant F-ratio for Factor [illegible] (mental age groupings) a need [illegible] to determine which level of Factor [illegible] was significantly

TABLE XXII

SUMMARY TABLE FOR ANALYSIS OF VARIANCE

MENTAL AGE VERSUS METHODS

Source of Variation	Sums of Squares	Degrees of Freedom	Mean-squares	F-ratio
Between Subjects				
A (Mental Age)	138.24	1	69.12	3.17*
Subjects within groups	1285.36	59	21.78	
Within Subjects				
B (Methods)	23.77	3	7.92	2.27
AB (Interaction)	32.01	6	5.33	1.53
Bx Subjects within groups	617.72	177	3.49	

*Significant at .05 level.

different from the others, in learning to recognize words by the four methods. Differences between all possible pairs of ordered means were tested by the Newman-Keuls procedure which uses the truncated studentized range statistic. These tests are presented in summary form in Table XXIII.

In the first section of Table XXIII, the means for the three mental age groupings have been placed in ascending order from left to right. The ordered means in ascending order are: a_3 Low Group, a_2 Middle Group, and a_1 High Group. The differences between all possible pairs have also been shown in the first section of the table. The third section of the table shows that the only means which were significantly different at the .05 level of confidence were a_1--the High Group, and a_3--the Low Group. This signifies that the children in the High Group of mental age were superior to the children in the Low Group on all methods of the Learning Methods Test. However, the children in the High and Middle Groups did not differ significantly from one another. Hence the data do not support the hypothesis of no significant relationship between mental age and learning to recognize words by the four methods.

When three levels of intelligence quotient were substituted for the three levels of mental age as the

TABLE XXIII

TESTS ON MEANS FOR THREE MENTAL AGE GROUPS

ON A LEARNING METHODS TEST

		a_3	a_2	a_1
Mental age groups		a_3	a_2	a_1
Ordered Means		3.26	4.27	5.34
(i)		a_3	a_2	a_1
Differences between pairs	a_3	—	1.01	2.08
	a_2		—	1.07
(ii) $s_{\bar{A}} = .54$		$r =$	2	3
$q_{.95}(r,59)$			2.83	3.40
$s_{\bar{B}}q_{.95}(r,59)$			1.53	1.83
(iii)		a_3	a_2	a_1
	a_3	—	—	*
	a_2			—

* Significant at .05 level

classification variable, the results obtained were similar to those of the original experiment reported above. The F-ratio for factor A (intelligence quotient) exceeded the critical value, and when the simple main effects of factor A were tested by the Newman-Keuls procedure the mean of the High Group (ranging from 116 to 148) was significantly higher (at the .01 level of confidence) than that of the Low Group (ranging from 84 to 104). However, the mean of the High Group was not significantly different from that of the Middle Group (ranging from 105 to 115). Thus the data for this sample did not support the hypothesis of no significant relationship between either mental age or intelligence quotient and learning to recognize words by the four methods of the Learning Methods Test.

Chronological Age versus Methods--Analysis of Variance III (N=62)

This analysis was designed to test the hypothesis of no significant relationship between chronological age and learning to recognize words by the four methods of the Learning Methods Test. Because of unequal cell frequencies and the need for a repeated measures design, the model of Winer (1962, p. 375) used in Analysis of Variance II, was followed.

classification variable, the results obtained were similar to those of the original unweighted [illegible] analysis. The results for Factor A (intelligence [illegible]) [illegible] tistical value, and when the simple main effects of Factor A were tested by the Newman-Keuls procedure the mean of the high group (ranging from 112 to 132) was significantly higher (at the .01 level of confidence) than that of the low group (ranging from 88 to 98). However, the mean of the high group was not significantly different from that of the middle group (ranging from 99 to 111). Thus the data from this [illegible] did not support the hypothesis of no significant relationship between either mental age or intelligence quotient and learning to recognize words by the four methods of the *Learning Methods Test*.

Chronological Age and Learning Methods—Hypothesis [illegible] Study III (1970)

This analysis was designed to test the hypothesis of no significant relationship between chronological age and learning to recognize words by the four methods of the *Learning Methods Test*. [illegible] [illegible] [illegible] [illegible] (Winer, 1962, p. [illegible]) [illegible] Variable II, [illegible].

The three levels of factor A--the classification variable--were selected by computing the upper and lower quartiles and the semi-interquartile range of the distribution of chronological ages for the sample. This selection resulted in three levels or groups of unequal size. The levels were designated:

a_1 -- Group I (ranging in age from 78 to 80 months)

a_2 -- Group II (ranging in age from 75 to 77 months)

a_3 -- Group III (ranging in age from 70 to 74 months)

As in the previously described factorial experiments, the treatment variables were the four methods and the criterion variable was the child's Delayed Recall score on each of the four methods. The data were subjected to an analysis of variance which is summarized in Table XXIV.

An examination of the data summarized in Table XXIV shows that the F-ratios for factor A (the chronological age groups)--1.84, for factor B (methods)--2.21, and for factor AB (interaction of methods and chronological age groups)--.99 do not exceed the critical values of 3.15, 2.66, and 2.15 respectively. Hence the experimental data support the hypothesis of no relationship between chronological age and learning to recognize words by the Visual, Auditory, Kinaesthetic, and Combination Methods of the <u>Learning Methods Test.</u>

TABLE XXIV

SUMMARY TABLE FOR ANALYSIS OF VARIANCE

CHRONOLOGICAL AGE VERSUS METHODS

Source of Variation	Sums of Squares	Degrees of Freedom	Mean-Squares	F-ratio
Between Subjects				
A (Chronological Age)	83.73	2	41.86	1.84
Subjects within groups	1339.87	59	22.71	
Within Subjects				
B (Methods)	23.77	3	7.92	2.21
AB (Interaction)	21.47	6	3.58	.99
Bx Subjects within groups	628.26	177	3.59	

Classes versus Methods--Analysis of Variance IV (N=62)

Following a policy of the school, the children had been assigned to the classes according to three chronological age groupings at the beginning of the school term. The Learning Methods Test was administered to the class in the oldest age group first, to the middle group second, and to the youngest group last. The allocation of the children to their respective classes and the choice of which class would be tested first was beyond the control of the investigator. The effects of these arrangements were: to reduce the range of chronological ages because the experiment carried over a ten-week period, and to allow the younger children to have more school experience before the test. To determine the effect of the differing length of school experience a three-by-four factorial experiment was designed to test the hypothesis of no relationship between classes, and learning to recognize words by the four methods of the Learning Methods Test.

The three levels of factor A--the classification variable--were the three classes. The data with regard to chronological age (as recorded at the time of the administration of the Learning Methods Test), mental age, and intelligence quotients of the three classes have been presented in Table II on page 91. The classes were designated:

a_1 -- Class I (n=22) -- ranging in age from 76 to 80 months with a mean of 78.1

a_2 -- Class II (n=20) -- ranging in age from 74 to 78 months with a mean of 75.3

a_3 -- Class III (n=20) -- ranging in age from 70 to 75 months with a mean of 73.0

The four levels of the treatment variables were the same four methods of the other three factorial experiments and the criterion variable was again the child's Delayed Recall score for each method. The data were tested by analysis of variance and a summary of the analysis has been recorded in Table XXV.

An examination of the data given in Table XXV reveals that the F-ratios for factor A (classes), 2.60, and factor B (methods), 2.29, did not exceed the respective critical values. However, the F-ratio of 3.22 for AB (interaction of classes and methods) exceeded the critical value of 2.15 for $F_{.95}$ (6, 177) and for $F_{.99}$ (6, 177) thus attaining statistical significance at well beyond the .01 level of confidence. Because of this significant interaction a test on simple main effects was called for.

The tests on simple main effects of factor A (classes) at the four levels of factor B (methods) showed that: (1) when all the observations were made at level b_1 (Visual Method) the resulting F-ratio of 4.96 was significant, (2) when all the observations were made at

a_1 — Class I ([illegible]) — ranging in age from [illegible] to [illegible] months with a mean of [illegible].

a_2 — Class II ([illegible]) — ranging in age from [illegible] to [illegible] months with a mean of [illegible].

a_3 — Class III ([illegible]) — ranging in age from [illegible] to [illegible] months with a mean of [illegible].

The four levels of the treatment variables were the same for each of the other three factors; [illegible] and the criterion variable was again the subject's [illegible] equal [illegible] for each method. The total mean squares of analysis of variance and a summary of the analysis are presented in Table XIV.

An examination of the data given in Table XIV reveals that the F-ratios for factor A (classes), [illegible], and factor B (methods), [illegible], did not exceed the tabulated critical values. However, the F-ratio of [illegible] for the interaction of classes and methods exceeded the critical value of [illegible] for $F_{.95}$ ([illegible]) and [illegible] thus attaining statistical significance at the [illegible] level of confidence. Because of this significant interaction, a test of simple main effects was carried out.

The means of [illegible] were [illegible] (Table [illegible]) by the four levels of Factor B (methods), [illegible] that: (1) when all the [illegible] were [illegible] F_1 [illegible] the resulting F-ratio, [illegible], was not significant; (2) when all the [illegible] with [illegible] —

TABLE XXV

SUMMARY TABLE FOR ANALYSIS OF VARIANCE

CLASSES VERSUS METHODS

Source of Variation	Sums of Squares	Degrees of Freedom	Mean-squares	F-ratio
Between Subjects				
A (Classes)	109.58	2	54.79	2.60
Subjects within groups	1244.02	59	21.08	
Within Subjects				
B (Methods)	23.77	3	7.92	2.29
AB (Interaction)	66.88	6	11.15	3.22**
Bx Subjects within groups	612.85	177	3.46	

**Significant at .01 level.

level b_2 (Auditory Method) the F-ratio of 4.03 was significant, and (3) when all the observations were made at level b_3 (Kinaesthetic Method) the resulting F-ratio of 4.02 was significant. These three F-ratios all exceeded the critical value of 3.56 and were significant at well beyond the .01 level of confidence. When all observations were made at level b_4 (Combination Method) the resulting F-ratio of 1.30 was non-significant. Hence the data tended to reject the hypothesis of no significant relationship between classes and learning to recognize words by one of the four methods. Therefore, differences between all possible pairs of means were tested by the Newman-Keuls procedure to determine which methods were superior for a particular class. The tests on means are summarized in Tables XXVI, XXVII, and XXVIII, (pages 177, 179, and 180).

The tests on the means for the three classes learning to recognize words by the Visual Method are summarized in Table XXVI. The ordered means in ascending order were: a_1 (Class I--the oldest group), a_2 (Class II--the middle group), and a_3 (Class III--the youngest group). The table shows that when the differences between all possible pairs of means were computed, the only means that could be considered significantly different, at the .01 level of confidence, were those of a_3 (Class III--the youngest group) and a_2 (Class II--the middle group). The mean for a_2 --

level s_2 (Positive Summer) the F-ratio of 1.2 was non-significant; and (2) when all the observations were made at level t_2 (Experimental School) the resulting F-ratio of 4.66 was significant. These three F-ratios all exceeded the critical value of 1.54 and were significant at or beyond the .05 level of confidence. When all observations were made at level t_1 (Conventional School) the resulting F-ratio of 1.50 was non-significant. Hence the null hypothesis [illegible] be rejected: the hypothesis of no significant differences between [illegible] and learning [illegible] [illegible] each [illegible] of the four periods. Therefore, [illegible] [illegible] [illegible] pairs of means were [illegible] in the Newman-Keuls procedure to determine which differed [illegible] [illegible] [illegible]. [illegible] [illegible] are shown [illegible] [illegible] in Tables [illegible], [illegible], and [illegible] (pages [illegible], [illegible], and [illegible]).

The [illegible] on the means for [illegible] [illegible] [illegible] [illegible] by the [illegible] [illegible] of the [illegible] [illegible] are [illegible] in Table [illegible]. The [illegible] [illegible] [illegible] [illegible] [illegible] a_2 ([illegible] [illegible] [illegible]), a_3 ([illegible] [illegible]) and a_1 ([illegible] [illegible] [illegible]). The [illegible] shows that when the differences between all possible pairs of means were computed, the only means that could be considered significantly different, at [illegible] [illegible] of confidence, were those of a_2 ([illegible] [illegible] [illegible]) and a_1 ([illegible] [illegible] [illegible]). The [illegible] [illegible] a_2 --

TABLE XXVI

TESTS ON MEANS OF THREE CLASSES FOR

THE VISUAL LEARNING METHOD

Classes	a_1	a_3	a_2
Ordered Means	3.27	5.10	5.90

(i)		a_1	a_3	a_2
Differences between pairs	a_1	——	1.83	2.63
	a_3		——	.80

(ii) $s_{\bar{A}} = .51$	$r =$	2	3
$q_{.95}(r,59)$		2.83	3.40
$s_{\bar{A}}q_{.95}(r,59)$		1.44	1.73

(iii)		a_1	a_3	a_2
	a_1	——	*	* **
	a_3			——

* Significant at .05 level
** Significant at .01 level

Class II was also significantly different at the .01 level. Thus Classes II and III were superior to Class I (the oldest group) in learning words by the Visual Method.

The tests on means for the three classes learning to recognize words by the Auditory Method are summarized in Table XXVII. The ordered means in ascending order were: a_1 (Class I--the oldest group), a_3 (Class III--the youngest group) and a_2 (Class II--the middle group). When all the possible differences between pairs were compared to the critical values, the only significant differences were between the mean for a_2 (Class II--the middle group) and the means for a_1 (Class I--the oldest group). Thus it can be stated (at the .01 level of confidence) that Class II (the middle group) in this sample was superior to Class I (the oldest group) in learning to recognize words by the Auditory Method.

The tests on the means for the three classes learning to recognize words by the Kinaesthetic Method are summarized in Table XXVIII. The ordered means in ascending order were: a_1 (Class I--the oldest group), a_3 (Class III--the youngest group), and a_2 (Class II--the middle group). The table shows that when the differences between all possible pairs of means have been compared with the critical values given in the second section of the table, the only pair of means which can be considered significantly

[illegible]

[illegible]

[illegible]

[illegible]

TABLE XXVII

TESTS ON MEANS OF THREE CLASSES FOR

THE AUDITORY LEARNING METHODS

			a_1	a_3	a_2
Classes			a_1	a_3	a_2
Ordered Means			3.23	4.60	5.65
(i)			a_1	a_3	a_2
		a_1	—	1.37	2.42
	Differences between pairs	a_3			1.05
	$s_{\bar{A}} = .51$		$r =$	2	3
(ii)	$q_{.95}(r,59)$			2.83	3.40
	$s_{\bar{A}}q_{.95}(r,59)$			1.44	1.73
(iii)			a_1	a_3	a_2
		a_1	—	—	* **
		a_3			—

* Significant at .05 level
** Significant at .01 level

TABLE XXVIII

TESTS ON MEANS OF THREE CLASSES FOR THE KINAESTHETIC LEARNING METHOD

Classes	a_1	a_3	a_2
Ordered Means	2.68	4.10	5.10

(i) Differences between pairs		a_1	a_3	a_2
	a_1	—	1.42	2.42
	a_3			1.00

(ii)		r =	2	3
	$s_{\bar{A}} = .51$			
	$q_{.95}(r,59)$		2.83	3.40
	$s_{\bar{A}}q_{.95}(r,59)$		1.44	1.73

(iii)		a_1	a_3	a_2
	a_1	—	—	* **
	a_3			—

* Significant at .05 level
** Significant at .01 level

different are a_2 and a_1. Hence it can be stated at the .01 level of confidence, that Class II--the children in the middle group--were superior to Class I--the oldest children--in learning to recognize words by the Kinaesthetic Method.

The tests on the simple main effects of factor B (methods) at the three levels of factor A (classes) showed that: (1) when all the observations were made at level a_1 (Class I--the oldest group) the resulting F-ratio of .65 was non-significant and (2) when all the observations were made at a_2 (Class II--the middle group) the resulting F-ratio of 1.46 was non-significant. However, when all the observations were made at level a_3 (Class III--the youngest group) the F-ratio of 3.73 exceeded the critical value of 2.66. Thus the interaction between Class III (the youngest group) and the four methods was significant at the .05 level of confidence. A test on the differences between all possible pairs of means was called for to determine which method (or methods) was superior for Class III (the youngest children). Again, the Newman-Keuls test was used. The tests on means are summarized in Table XXIX.

Table XXIX shows the ordered means for Class III (the youngest children) on the four methods. The means arranged in order of size were: b_3 (Kinaesthetic), and b_4 (Combination), b_2 (Auditory, and b_1 (Visual). Because Class III had identical means on the Kinaesthetic and

different are a_2 and a_3. Hence it can be stated at the .05 level of confidence, that Class III--the individuals in the middle group--were superior to Class I--the oldest group--in learning to recognize words in the experimental situation.

The tests to the simple main effects of Factor B (methods) at the three levels of Factor A (classes) showed that: (1) when all the observations were made at level a_1 (Class I--the oldest group) the resulting F-ratio was non-significant and (2) when all the observations were made at a_2 (Class II--the middle group) the resulting F-ratio of 1.60 was non-significant. However, when all the observations were made at level a_3 (Class III--the youngest group) the F-ratio of 4.85 exceeded the critical value of 2.86. Thus the interaction between Class III (the youngest group) and the four methods was significant at the .05 level of confidence. A test on the differences between all possible pairs of means was then needed to determine which method (or methods) was superior for Class III (the youngest children). Again, the Newman-Keuls test was used. The steps in making the comparisons of pairs follow.

Table XXI shows the ordered means for Class III (the youngest children) on the four methods. The means arranged in order of size were: b_4 (Kinaesthetic), and b_2 (Combination), b_1 (Auditory), and b_3 (Visual). Class III the ordered means on the Newman-Keuls test are

TABLE XXIX

TESTS ON MEANS FOR CLASS THREE ON

FOUR METHODS OF WORD RECOGNITION

Methods		b_3--b_4	b_2	b_1
Ordered means		4.10	4.60	5.10
(i)		b_3--b_4	b_2	b_1
	b_3--b_4	——	.50	1.00
Differences between pairs	b_2			.50
(ii) $s_{\overline{B}} = .24$		r =	2	3
$q_{.95}(r,177)$			2.77	3.31
$s_{\overline{B}}q_{.95}(r,177)$			.66	.79
(iii)		b_3--b_4	b_2	b_1
	b_3--b_4	——	——	* **
	b_2			——

* Significant at .05 level
** Significant at .01 level
b_3--b_4 Identical Means

Combination Methods, these methods were considered as one for the purposes of determining the truncated range "r"--the number of steps that separate each mean from the other. The differences between all possible pairs in the first section of the table were checked against the critical values given in the second section. The third section of the table shows that the mean b_1 (Visual Method) can be considered significantly different from b_3 (Kinaesthetic Method) and b_4 (Combination Method). Hence for the children in Class III (the youngest children) it can be stated, at the .01 level of confidence, that the Visual Method was superior to the Kinaesthetic and Combination Methods, but it can not be considered significantly different from the Auditory Method of learning to recognize words.

VI. SUMMARY OF FINDINGS FROM THE ANALYSES OF VARIANCE

The findings from the analyses of variance, which have been given in tabular form and then explained, are summarized under the appropriate headings below:

<u>Sex</u>

1. Neither sex was superior to the other in learning by any one of the four methods.

2. The girls showed no significant differences in

learning to recognize words by any of the four methods.

3. For the boys, learning to recognize words by the Auditory and Visual Methods was significantly superior (at the .01 level of confidence) to the Kinaesthetic Method. Auditory and Visual Methods were also significantly superior, at the .05 and .01 levels of confidence respectively, to the Combination Method. However, there was no significant difference between the Visual and Auditory Methods for the boys.

Intelligence

1. Children in the High Group of mental age (ranging from 84 to 124 months) learned to recognize words, by all methods of the Learning Methods Test, significantly better (at the .05 level of confidence) than those children of the Low Group (ranging from 64 to 78 months). The differences in mean performance of the High Group and Middle Group (ranging from 79 to 88 months) were non-significant.

2. Children in the High Group of intelligence quotients (ranging from 116 to 148) were significantly superior (at the .01 level of confidence) to the Low Group (ranging from 84 to 104) on all methods of learning to recognize words. However, the differences in means between the High Group and Middle Group (ranging

from 105 to 115) were non-significant.

Chronological Age

1. There was no significant relationship between chronological age and learning to recognize words by any of the four methods of the Learning Methods Test.

Classes

1. Class II, the children in the middle age group, (ranging from 74 to 78 months with a mean of 78.1) and Class III, the youngest children (ranging from 70 to 75 months with a mean of 75.3) were significantly superior at the .05 level of confidence to Class I, the older children (ranging from 76 to 80 months with a mean of 73.0), in learning to recognize words by the Visual Method.

2. Class II, the children in the middle group of chronological ages, were significantly superior (beyond the .01 level of confidence) to Class I, the oldest children, in learning to recognize words by the Auditory Method.

3. Class II, the children in the middle group of chronological ages, was significantly superior (at well beyond the .01 level of confidence) to Class I, the oldest children, in learning to recognize words by the Kinaesthetic Method.

4. There were no significant differences between classes in learning to recognize words by the Combination Method.

5. For Class III, the youngest children, the Visual Method was significantly superior (at the .01 level of confidence) to the Kinaesthetic and Combination Methods of learning to recognize words. There was no significant difference between the Visual and Auditory Methods for this class.

6. No method was significantly superior or inferior for Class I, the oldest children, or for Class II, the children in the middle group of chronological ages.

VII. SUMMARY STATEMENT

The data obtained from the experimental study of visual, auditory, kinaesthetic, and combination methods of learning for grade one entrants have been presented in this chapter. By use of statistical computation, an attempt has been made to show the interrelationship of these methods as well as their relationship to other factors such as sex, chronological age, intelligence and class placement. The statistical computation has been analyzed and explained. The implications and conclusions drawn from these findings will be presented in the final chapter.

CHAPTER V

CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

This study has attempted to determine the most effective method--visual, auditory, kinaesthetic, or combination--for teaching word recognition to the first-grade entrants of one large, urban public school.

The *Learning Methods Test*, the main test instrument used in the study, was administered individually to the sixty-two children in the sample. Appropriate sections of four other tests were used in an effort to find corroborative evidence of preference for a particular sensory mode of learning.

Data obtained from the class records and the test results were intercorrelated to see what common bonds existed among the tests, and between each test and the variables of sex, intelligence, and chronological age. Four analyses of variance were used to test the relationship between delayed recall scores on the *Learning Methods Test* and the variables of sex, chronological age, intelligence, and class placement.

The following null hypotheses have been tested and statistical data support what appear to be valid conclusions.

I. CONCLUSIONS

Hypothesis I.

> There is no significant relationship between children's aptitudes to learn by any one of the four methods--Visual, Auditory, Kinaesthetic or Combination --of the Learning Methods Test and other tests designed to assess the same sensory mode of learning.

Correlations between the children's performance on any one method of the Learning Methods Test and the tests designed to assess the same sensory mode of learning varied from negligible or low negative to highly significant. The level of significance tended to be a function of the type of recall being compared and the sex of the children whose performance was being considered.

Visual Method

Immediate Recall. For the group as a whole, performance on the test of Immediate Recall of words taught by the Visual Method was significantly correlated with the majority (seven out of eleven) of the other visual tests. Apparently, the children's performance on the test of Immediate Recall was closely correlated with their abilities in: (1) visual memory (immediate or delayed) and (2) visual discrimination and observation of internal detail, external detail, size, orientation, and placement of geometric forms, word-like configurations, letters and

C. [illegible]

Hypothesis [illegible]

There is no significant relationship between [illegible] [illegible] on learning any one of the four [illegible]-[illegible], [illegible], [illegible] or [illegible] —[illegible] [illegible] [illegible] and [illegible] [illegible] [illegible] [illegible] of learning.

Correlations between the children's performance on the one subtest of the Learning Methods Test and the tests designed to assess the same memory mode or learning method (see description of the respective [illegible] [illegible]). The lack of significance seemed to be a function of the type of recall being measured and the use of the children whose performances are being [illegible].

Visual Method

Immediate Recall. For the group as a whole, performance on the test of immediate recall of words taught by the visual method was significantly correlated with the majority (seven out of eleven) of the [illegible] tests. Apparently, the children's performance on the test of immediate recall was closely associated with their abilities in: (1) visual memory (immediate or [illegible]) and (2) visual discrimination and [illegible] of [illegible] details, [illegible] [illegible], [illegible] [illegible], and [illegible] of geometric forms, [illegible] [illegible], [illegible] and

words. The negligible relationship between Immediate Recall and the Monroe test of Memory of Orientation of Form should be noted, in contrast to the significant correlation between Immediate Recall and another Monroe test, that of Form Memory. The differences in the type of response called for in the two tests may be largely responsible for their contrasting relationship to Immediate Recall. On the test of Memory of Orientation of Form the children were required to identify, by circling in their booklets, the form which matched the one shown to them by the examiner; on the test of Form Memory they were required to recall and reproduce a series of four geometric forms. Thus the task of the former test involved mainly recognition, while that of the latter involved recall and a written response (i.e. the drawings) and more closely resembled the task of Immediate Recall which required not only recognition of the words, but recall in the form of a verbal response.

Performance on the test of Immediate Recall showed significant correlations with four of the other eleven visual tests for the boys and four for the girls. The significant correlations between Immediate Recall and the Letters and Words Total and the Grand Total of the <u>Visual Discrimination Tests</u> were common to both sexes. Except for the negative correlation with Form Memory, the boys'

words. The Auditory Discrimination, Sentence Recall and the Memory test of Memory of Information of Form results is noted. In contrast to the significant correlation between Immediate Recall and Auditory Discrimination of Form Memory. The difference in the types of responses called for in the two tests may be largely responsible for their contrasting relationship to immediate recall. In the test of Memory of Information, of Form the children were required to identify, by pointing to their responses, the item which matched the item shown to the subject. On the test of Form Memory they were required to recall and reproduce a series of five geometric forms. Thus the task of the Form Memory test, the … reproduction, and … immediate recall and a … … the … more closely resembles the task of Immediate Recall which required the oral reproduction of the letters … recall in the form of a verbal response.

Performance on the test of … Recall showed significant correlations with four of the other visual perceptual tests for the boys and four for the girls. The significant correlations between … Recall and … Perception and Form … and … Visual Discrimination of Form were common to both sexes. … two negative correlations with Form Memory, … …

performance on the test of Immediate Recall showed positive relationships with all of the other tests and significant correlations with the Pintner-Cunningham Primary subtests of Dot Drawing and Picture Completion. For the girls, the highest relationships for Immediate Recall were with the tests of visual aptitude and visual discrimination, while the lowest were with the subtests of the Pintner-Cunningham Primary--Associated Objects, Picture Parts and Picture Completion.

Delayed Recall. Although there was a highly significant correlation between Immediate Recall and Delayed Recall of words taught by the Visual Method, the Delayed Recall showed a much lower relationship to the other eleven visual tests. For the total group, Delayed Recall showed positive correlations with all of the other tests but the only significant correlations were with Dot Drawing and the Visual Discrimination Tests. Evidently, for the children in this sample, delayed visual memory for words was more closely related to their abilities to keep in mind a configuration against distraction (such as other items of choice or significant details within a whole) than to their abilities to make gross discriminations or to hold in mind a simple configuration during timed perception (as on the tests of Associated Objects, Picture

Parts or Memory of Orientation of Form). This seems to be borne out by the higher relationship between Delayed Recall and tests requiring discrimination between similar letters, words, and forms or patterns in which they must attend to external and internal detail, as well as the wholeness of the figure. This is in agreement with the findings of Goins (1958, p. 23) that the superior readers were those who could keep in mind the whole while attending to its significant details. Goins referred to this factor of visual perception as "strength of closure."

Delayed Recall showed positive correlations with all but one of the visual tests for boys and girls considered separately. None of the correlations reached the accepted significance level for the boys but for the girls three were significant. The performances of both sexes on the test of Delayed Recall were closely related to their performances on the tests of visual discrimination which involved gross and minute detail. However, for the boys, the correlations between Delayed Recall and the tests of the <u>Monroe Reading Aptitude</u> (Visual), which involve largely form discrimination, were much lower than those of the girls. Apparently, the girls utilized more of the same types of clues to aid in their recall of both geometric forms and letters (or words) than the boys did.

It would appear that there is a significant rela-

tionship between children's aptitudes to learn by the Visual Method of the Learning Methods Test and their performance on tests designed to assess a visual mode of learning. There was a high relationship between Immediate Recall and the majority of visual tests. The relationship between Delayed Recall and these same tests was much lower. Forgetting, the negative aspect of remembering, tends to be more rapid at first and slower after a time. It should follow then that, compared to Immediate Recall, Delayed Recall is a more stable measure of word recognition and more closely resembles the task of acquiring a sight vocabulary in reading. Therefore, it is important to note that it correlated significantly with those tests (i.e. Dot Drawing and the Visual Discrimination Tests) which measured the relatively more subtle powers of visual discrimination and visual memory that are involved in learning to recognize words by the Visual Method.

Auditory Method

For the total group and boys and girls considered separately, the correlations of both recall tests of the Auditory Method were negligible or negative with all but one of the five auditory tests. Both Immediate Recall and Delayed Recall showed highly significant relationships to the Wepman Auditory Discrimination Test for the total

[illegible]

[illegible]

[illegible]

group, for boys, and for girls. The findings with regard to the significant correlation between auditory discrimination and success in word recognition concur with those of Wepman (1960, 1961) in his extensive clinical experience and research in the area of audition and also with Thompson (1963) in her longitudinal study of auditory discrimination.

The low relationship between both recall tests and the tests of Word Discrimination, Sound Blending, and Auditory Memory may not necessarily mean that these auditory abilities, suggested by the names of the tests, are not closely related to success in learning to recognize words by the Auditory Method. The low correlations may be, in part at least, a function of the particular test used to measure these abilities. In Chapter IV it was shown that Word Discrimination and Sequence, while requiring some ability in auditory discrimination and auditory memory for sequential patterning, also required considerable ability in visual discrimination. In fact, it correlated very significantly with some selected tests of visual discrimination and may possibly be a better measure of the latter than of either auditory discrimination or memory for an auditory sequence. Auditory Memory, as measured by story memory, involves much more than the auditory memory for sounds or words, required in learning

[illegible]

[illegible]

to recognize words by an auditory or phonic method.

Evidently, for the children in this sample, learning to recognize words by the Auditory Method of the Learning Methods Test was significantly related to their ability to discriminate between similarities and differences in words as measured by the Wepman Auditory Discrimination Test. However, recall of words taught by the Auditory Method showed a very low relationship with a composite measure of auditory word discrimination, sequence, and matching (with a visual symbol) and with sound blending and auditory story memory as measured by the Monroe Reading Aptitude (Auditory Aptitude subtests).

Kinaesthetic Method

Immediate Recall. For the group as a whole the test of Immediate Recall for the Kinaesthetic Method showed positive correlations with all but one of the nine tests designated as kinaesthetic-motor tests. However, the only tests with which it correlated significantly were the Monroe test of Writing Name and the Visual Discrimination Tests--Pattern Copying.

The girls' performance on the test of Immediate Recall showed positive correlations which approached the accepted level of significance with their performance in Writing Name and with Pattern Copying and Pattern Completion

from the <u>Visual Discrimination Tests</u> (Form). For the boys, the correlations of Immediate Recall with the other kinaesthetic-motor tests followed much the same pattern as those for the girls and significant correlations were revealed with Writing Name and Dot Drawing.

For these children, the task of writing their own name was quite similar to the tracing of words involved in the Kinaesthetic Method but without any apparent auditory or visual cues. Proficiency in the ability to write their own names probably facilitated completion of the motor components of the tracing movements so that more of their attention could be devoted to the accompanying visual, auditory, and kinaesthetic cues, in learning to recognize the words. The high correlation between Immediate Recall and Dot Drawing for the boys suggests that the visual perceptual abilities of maintaining: (1) positional relationships between points of reference and (2) figure-ground relationships were significant in learning to recognize words by the Kinaesthetic Method. Apparently, these factors were of lesser significance to the girls.

<u>Delayed Recall</u>. Delayed Recall of words learned by the Kinaesthetic Method generally showed higher relationships with the kinaesthetic-motor tests than

did Immediate Recall. For the total group, Delayed Recall correlated very significantly with Dot Drawing, Writing Name, Pattern Copying, and Pattern Completion.

The significant correlations of Delayed Recall with Pattern Copying were common to both sexes. The performances of both the boys and the girls showed a close relationship with Pattern Completion and Writing Name. The latter relationship was significant for the girls. Delayed Recall was significantly correlated with Dot Drawing for the boys but showed a low relationship to this same test for the girls.

The test of Delayed Recall was considered to be a more stable measure of word recognition and therefore more important from the point of view of the present study. Because of this, the significant relationship between Delayed Recall and performance on the tests of visual form perception, as measured by copying ability, should be regarded with considerable interest. Robinson and others (1958, p. 522) found correlations ranging from .37 to .44 when results of a test designed to measure the child's perception of form and adequacy of figure-ground relationships were compared with reading achievement in first-grade children. Potter (1949) reported a correlation of .60 between a task of copying forms and reading achievement in the first grade. These coefficients

[illegible]

[illegible]. For the total group, [illegible]

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[illegible] more important from the point of view of the present study, [illegible]

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of correlation closely approximate the coefficients usually found when intelligence is correlated with reading achievement. Even with an overlap in measurement between the tests of form perception and intelligence tests, the former should still be useful as predictors of reading achievement.

It would appear that, for the children in this sample, there was a high and often significant relationship between learning to recognize words by the Kinaesthetic Method (as adapted for this study) and performance on the tests of visual form perception, as measured by pattern copying, pattern completion, dot drawing and writing their own names. All of these tests involve integration and re-organization of material before making a response. The significance of this relationship is further validated by the higher correlations of Delayed Recall with these tests.

Combination Method

Positive correlations were shown between both of the recall tests for the Combination Method of learning to recognize words and the other two combination tests. For the most part, the relationships between the recall tests and the other tests were negligible or indifferent, although the identical correlations between both recall tests and the *Monroe Reading Aptitude*--Total Score were only slightly below the accepted significance level for

the girls. It should be noted that the total score of the *Monroe Reading Aptitude* includes scores from subtests of Articulation and Language. For the girls it was much more closely correlated with the recall tests of the Combination Method than the total score for the tests of visual, auditory, and motor aptitude. The importance of the relevance of facility in language to a multi-sensory approach in learning to recognize words is emphasized by this relationship.

Apparently, children's aptitudes to learn by the Combination Method of the *Learning Methods Test* are not significantly related to their performances on composite measures of visual, auditory, and motor aptitudes as measured by the *Monroe Reading Aptitude* test.

Summary of Conclusions from Hypothesis I

For this sample, there was a significant relationship between aptitude to learn by the Visual Method and performance on the majority of tests designed to assess a visual mode of learning. The children's immediate recall of words bore a higher relationship to their scores on those tests which required both recognition and recall (in the form of a written response), rather than recognition alone (as indicated by some mark of identification). Delayed Recall, the more stable measure of word recognition and most important in the acquisition of a sight

vocabulary, related significantly to performance on those tests which involved holding in mind the wholeness of a figure while concomitantly attending to significant details or parts. Aptitude in learning to recognize words by the Visual Method was shown to be most closely correlated with performance on tests of visual memory or visual discrimination of forms, word-like shapes, letters or words.

Children's aptitudes to learn by the Auditory Method were highly correlated with their abilities in auditory word discrimination. However, these aptitudes showed a low relationship with a composite measure of auditory discrimination, sequence memory, and auditory and visual matching ability and with sound blending and auditory story memory. It is possible that the tests purporting to measure these abilities may have a higher loading of other factors such as ideational or language facility, visual discrimination, or experience.

Children's immediate and delayed recall of words learned by the Kinaesthetic Method showed positive correlations with the majority of the kinaesthetic-motor tests but their delayed recall of the words was much closer in its relationship to the other tests. Both immediate and delayed recall correlated closely with performance on the tests of visual-motor form perception. Learning to recognize words by the Kinaesthetic Method appeared to

have a high relationship to form-copying ability, as measured by tests of dot drawing, pattern copying, pattern completion, and writing a name.

Learning to recognize words by the Combination Method showed a low relationship with performance on the other two combination tests. The girls' performance on this method was closely, though not quite significantly, related to their performance on the total of the _Monroe Reading Aptitude_ which includes measures of Articulation and Language as well as the scores for visual, auditory, and motor aptitude.

It may be concluded that there is a positive relationship between learning to recognize words by any one method of the _Learning Methods Test_ and performance on tests designed to measure the same sensory mode of learning. It seems safe to conclude that the level of significance for this relationship varies with: (1) the sensory mode involved, (2) sex of the learner, (3) the type of recall used as the criterion of learning, and (4) the purity of measure for a particular perceptual ability.

Hypothesis II.

> There is no significant relationship between chronological age, intelligence, or sex and children's aptitude to learn by any one of the following types of sensory learning: (1) visual, (2) auditory, (3) kinaesthetic, or (4) combination.

Chronological Age

Correlations between chronological age and performance on the majority of visual, auditory, kinaesthetic-motor, and combination tests were either negligible or negative. Chronological age correlated significantly with performance on three out of thirty-three tests--Associated Objects, Auditory Memory, and Auditory Aptitude--for the total group and for the boys. For the girls, there were no significant correlations between chronological age and performance on the various tests of sensory learning.

Summary of Conclusions from Hypothesis II--Chronological Age

It may be concluded that, for the children in this sample, there was no significant relationship between chronological age and aptitude to learn by visual, kinaesthetic, or combined sensory modes. Apparently, the older boys were significantly better than the younger boys on tests of auditory aptitude, particularly auditory story memory. Possibly the older boys have had more experience in listening.

Intelligence

For the group as a whole, measured intelligence was closely related to performance on the majority of tests designed to assess the various types of sensory learning.

Both mental age and intelligence quotient correlated significantly with twelve out of thirteen visual tests, four out of seven auditory tests, seven out of nine kinaesthetic-motor tests, and three out of four combination tests.

The relationship between intelligence and performance on the tests of sensory learning was much closer for the boys than it was for the girls. For the girls, intelligence quotient showed a higher number of significant correlations than mental age with the sensory tests. Since the girls were significantly older than the boys it is possible that maturation or experience factors may have masked the true relationship between intelligence and test performance for the girls.

Performance on the visual tests showed a higher number and a higher level of significant correlations than were shown for the other tests of sensory learning when correlated with intelligence. This may be partially due to the overlap in measurement between the intelligence and visual tests. It should be pointed out that this higher relationship between intelligence and performance on the visual tests held true even without considering the visual subtests selected from the Pintner-Cunningham Primary, as part of the total number. Performance on tests of visual aptitude (as measured by the Monroe tests) and visual discrimination (of forms and of letters and

Both mental age and intelligence quotient correlated sig-
nificantly with [illegible]

[illegible]

The relationship between intelligence and achieve-
ment in the areas of sensory learning was much greater for
the boys than it was for the girls. For the girls,
intelligence [illegible] a higher number of [illegible]

[illegible]

Performance on the visual areas showed a higher
number and a higher level of significant correlations
than were shown for the other areas of sensory learning
when correlated with intelligence. This may be partially
due to the [illegible]
and visual tests. It should be pointed out that the
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words) correlated very significantly with intelligence for the total group and the boys. However, visual tests of identification of commonly associated objects and of letter and word discrimination showed a markedly lower correlation with intelligence for the girls.

Compared to the visual, kinaesthetic-motor, and combination tests, the auditory tests showed a proportionately lower number of significant correlations with intelligence. Sound blending ability and auditory story memory showed little or no relationship to intelligence. Possibly training and experience in listening may contribute more to the development of these abilities than does intelligence. However, for the total group and for the boys intelligence correlated significantly with: (1) auditory word discrimination (as measured by the Wepman test), (2) learning to recognize words by an auditory method, and (3) auditory discrimination and memory for a sequence of words, one of which was to be matched with a visual symbol (i.e. a picture). There was little or no correlation between intelligence and performance in auditory word discrimination for the girls. Reid (1962) found a lower relationship between intelligence and the performance of the boys in her sample on tests of auditory word discrimination, but the differences between the performance of the boys and girls were considerably reduced when the

group was retested later in the year. In Reid's sample the boys were significantly older, but in the present sample the girls were significantly older. These findings are supported by those of Wepman with regard to the developmental nature of auditory discrimination (1960, p. 325). However, both Wepman and Reid found the correlations between auditory discrimination and intelligence to be much lower than those of the present study.

With the exception of two tests, the correlations between intelligence and the kinaesthetic-motor tests were very significant. The two exceptions were the Monroe tests of Motor Steadiness (an ocular-motor test designed to measure the child's ability to follow a straight line) and Writing Name. Performance on both of these tests showed negligible correlations with intelligence. Success in these tests is probably more closely related to experience than intelligence.

For the group as a whole, performance on the combination tests was significantly correlated with intelligence. The correlation of intelligence with performance on a composite measure of visual, auditory and motor aptitude was much lower for the girls than for the boys and correlations of intelligence and performance on the combination tests were generally lower for the girls.

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<u>Summary of Conclusions from Hypothesis II--Intelligence</u>

It may be concluded that, with the exception of the girls' performance on a test of identification of commonly associated objects and tests of letter and word discrimination, performance on the visual tests was very significantly related to intelligence, as measured by the *Pintner-Cunningham Primary*.

Performance on tests designed to measure auditory aptitudes showed a relatively lower number of significant correlations with intelligence. Auditory word discrimination and sequence memory (used in auditory and visual matching) and learning to recognize words by an auditory method were generally significant when correlated with intelligence but auditory story memory and sound blending ability showed little relationship to intelligence. Auditory word discrimination (as measured by the Wepman test) was significantly related to intelligence for the total group and for the boys but showed little relationship to intelligence for the girls.

Except for performance on tests of writing their name or eye-hand steadiness in following a straight line, the children's performance on the kinaesthetic-motor tests was significantly related to intelligence.

For the group as a whole, performance on the combination tests showed significant correlations with

intelligence but the correlations for the girls were markedly lower than those for the boys.

Sex

In the comparison of means for the thirteen visual tests, it was found that nine of the observed differences favored the girls, three favored the boys, and one pair of means was identical for the sexes. The only significant difference favored the girls on the test of Picture Completion from the Pintner-Cunningham Primary. Apparently, the boys and girls were of approximately equal ability in visual memory, visual association, and visual discrimination of letters, words, and geometric forms. However, the mean performance of the boys was lower in those tests which involved speed of perception.

All of the observed differences in means for the seven auditory tests favored the girls but the only significant differences between the sexes were in their means on the Monroe test of Sound Blending and Auditory Aptitude Total.

Comparison of means on the nine kinaesthetic-motor tests showed that six of the observed differences favored the girls and two favored the boys. The girls obtained significantly higher means on the Monroe tests of Motor Speed and Motor Aptitude Total.

Three out of four observed differences in means favored the girls on the combination tests and their mean on the Visual-Auditory-Motor Aptitude Total was significantly higher than that of the boys.

Summary of Conclusions from Hypothesis II--Sex

In all then, on twenty-three out of thirty-three tests of sensory learning, the observed differences favored the girls, but only six of these differences reached the accepted significance level. The boys and girls were approximately equal in intelligence, as measured by the Pintner-Cunningham Primary test, but the girls were significantly older in chronological age. In examining the correlations of intelligence and chronological age with the six tests on which the girls obtained significantly higher means, two observations were made. First, it was observed that of these six tests, the only test which correlated significantly with intelligence for the girls was the Pintner-Cunningham Primary subtest of Picture Completion; the other five tests showed a negligible or negative relationship to intelligence for the girls. Secondly, it was observed that these tests showed negligible or negative correlations with chronological age for the girls. It would seem that the superiority of the girls on these tests, particularly those of audi-

[illegible] (see Chapter [illegible]) [illegible] [illegible] [illegible] the girls on the [illegible] [illegible] than boys [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] higher than that of the boys.

Summary of [illegible] for the [illegible] Group

In all [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible], the observed [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. The boys and girls were [illegible] equal in [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible], the girls were significantly older in chronological age. [illegible] [illegible] the [illegible] of [illegible] and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. First, it was observed that on [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the girls [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of negative relationship to [illegible] [illegible] girls. Secondly, it was observed that [illegible] [illegible] [illegible] of negative [illegible] [illegible] [illegible] against the girls. It would seem that the [illegible] of the girls on these tests, particularly [illegible] [illegible]

tory and motor aptitude, can not be attributed to their chronological age advantage *per se*.

It would appear that there is a relationship between the sex of the children and their performance on tests designed to measure the various types of sensory learning. The superior performance of the girls, on tests of auditory and motor aptitude, suggests that maturational sex differences and/or more pre-school experience with similar tasks, may be factors that are operative in the girls' favor.

Hypothesis III.

> There is no significant relationship between children's aptitudes to learn by any one of the four methods--Visual, Auditory, Kinaesthetic, or Combination--of the *Learning Methods Test* and any one of the following pupil variables: (1) sex, (2) intelligence, (3) chronological age, and (4) class placement.

The conclusions, discussed and summarized below, are based on the findings from the four analyses of variance and subsequent tests of significance. In each analysis the criterion variable was the child's Delayed Recall score for each of the four methods of the *Learning Methods Test*.

Sex

From the analysis, Sex versus Methods, it was shown that neither sex was significantly superior to the

other in learning to recognize words by any one method of the Learning Methods Test. There were no significant differences in the number of words that the girls learned to recognize, regardless of the learning method. However, word recognition for the boys was significantly affected by the learning methods used. For the boys, the Visual and Auditory Methods proved to be almost equally effective but both of these were significantly better learning methods than either the Kinaesthetic or Combination Methods.

The main factor common to both the Kinaesthetic and Combination Methods was the emphasis upon the kinaesthetic or tactile elements in learning to recognize words. Apparently, the boys were less able than the girls to profit from this emphasis upon kinaesthesis. The girls were significantly older in chronological age and, as indicated previously, they were significantly superior in their performance on the tests of Motor Speed and Motor Aptitude. It is possible that the boys had to devote more of their energies to the actual tracing movements of the Kinaesthetic and Combination Methods, completed fewer tracings and, as a consequence, received less kinaesthetic reinforcement within the same time limits as the girls.

The findings of no significant differences between the sexes, for any of the methods, are in agree-

[illegible] in learning to recognize words in the [illegible] stage of
the *Metropolitan Readiness Tests*. There were no significant
differences in the number of words boys and girls learned
to recognize, regardless of the learning method. However,
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by the learning methods used. For the boys, the [illegible]
and Auditory methods proved to be [illegible] effective,
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methods than either the Kinesthetic or Combination methods.

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and Combination Methods are the methods [illegible]
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The findings of no significant difference
between the sexes, for any of the methods [illegible]

ment with those of Mills (1956, p. 223) who used twenty-four pairs of boys and girls, matched in relation to chronological age, reading level, and intelligence. However, the youngest children in his sample were one year older and he apparently did not investigate the relative merits of the methods for each sex.

Summary of Conclusions from Hypothesis III--Sex

It may be concluded that there was no significant relationship between sex and overall performance in learning to recognize words by the four methods of the *Learning Methods Test*. However, it must be further concluded that, while girls learned almost equally well by all methods, the boys learned to recognize words significantly better by the Visual and Auditory Methods than by the Kinaesthetic or Combination Methods.

Intelligence

The findings from the analysis of Intelligence versus Methods support the conclusion that, in this sample, the children in the High Group of intelligence learned to recognize words by all methods of the *Learning Methods Test* significantly better than the children in the Low Group. However, there were no significant differences between the children in the High Group and

ment with those of Mills (1956, p. 227) who used twenty-four pairs of boys and girls, matched in relation to chronological age, reading level, and intelligence. However, the youngest children in his sample were one year older and he apparently did not investigate the relative merits of the methods for each sex.

Summary of Conclusions from Sub-Section 1 (Sex)

It may be concluded that there were no significant relationships between sex and overall performance in learning to recognize words by the four methods of the Learning Methods Test. However, it should be pointed out that, while girls learned almost equally well by all methods, the boys learned to recognize words significantly poorer by the Visual and Auditory Methods than by the Kinaesthetic and Combination Methods.

Intelligence

The findings from the analysis of intelligence versus methods support the conclusion that, in this sample, the children in the high group of intelligence learned to recognize words by all methods on the Learning Methods Test significantly better than the children in the low group. However, there were no significant differences between the children in the high group and

Middle Group of intelligence.

When the children were grouped according to mental ages those in the High Group and those in the Low Group attained their highest means by the Visual Method and their lowest means by the Kinaesthetic Method but there was little variance in the means attained by the Middle Group for the four methods. When the same children were regrouped according to intelligence quotient the only change in the relative size of the means was for the High Group. The mean for the Visual Method remained the highest for the High Group but the mean for the Combination Method was the lowest.

Summary of Conclusions from Hypothesis III--Intelligence

It may be concluded that there was a significant relationship between the children's intelligence level and their overall performance in learning words by the four methods of the Learning Methods Test. However, no single method was significantly better for any of the three mental ability groups, although the children in both the highest and lowest levels of intelligence tended to learn most effectively by the Visual Method and least effectively by the Kinaesthetic Method.

Chronological Age

The findings from the analysis of Chronological Age

versus Methods showed that there were no significant differences between the children in the three chronological age groups in learning to recognize words by all of the four learning methods of the Learning Methods Test.

These findings are supported by those of Mills (1956, p. 225) who found no consistent relationship between age and a child's aptitude to learn by any of the four methods. It is also interesting to note that for the oldest children in this study--those who ranged from 78 to 80 months--the Visual Method tended to be the best and the Kinaesthetic Method tended to be the poorest. This agreed with the findings of Mills in regard to the seven-year old children learning by the four methods.

Summary of Conclusions from Hypothesis III--Chronological Age

It may be concluded that, for the children in this sample, there was no significant relationship between chronological age and learning to recognize words by visual, auditory, kinaesthetic or combined methods, as measured by the Learning Methods Test. However, there was a tendency for the oldest and youngest children to learn more effectively by the Visual Method and least effectively by the Kinaesthetic Method.

Class Placement

The findings from the analysis of Classes versus

Methods show that there were significant differences, between and within classes, in learning to recognize words by the four methods of the Learning Methods Test. The three classes differed in chronological age and in the length of school experience. (The latter difference occurred because the testing carried over ten weeks.) The only significant differences in intelligence were between Class II and Class III. The between-class differences in word recognition were:

1. Class II (the children in the middle group of chronological ages) was significantly superior to Class I (the oldest children) in learning by the Visual, Auditory, and Kinaesthetic Methods.

2. Class III (the youngest children) was significantly superior to Class I (the oldest children) in learning by the Auditory Method.

The within-class differences were only significant for Class III. For these younger children, the Visual Method was significantly more effective than the Kinaesthetic or Combination Method.

Summary of Conclusion from Hypothesis III--Class Placement

It may be concluded that there was a significant relationship between the children's class placement and their aptitude to learn by the four methods of the

Learning Methods Test. Since it has been shown that there was no significant relationship between chronological age and learning to recognize words by the four methods, it seems safe to conclude that there was some relationship between the differing lengths of school experience for each of the classes and aptitude to learn by the Visual and Auditory Methods and, to a lesser degree, the Kinaesthetic Method.

II. GENERAL CONCLUSIONS

The findings of this study provide fairly conclusive evidence that different children learn to recognize words more efficiently by certain methods of instruction and that no one method is best for all. The methods were differentiated by the amount of emphasis given to three basic sensory modes of learning--visual, auditory, and kinaesthetic--or to a combination of the three. What appear to be valid conclusions, regarding the relative effectiveness of the four methods for certain types of children, have been presented. In general, the higher the intelligence, the more readily the children learned to recognize words by all methods. There was no consistent relationship between a child's chronological age and his aptitude to learn words by any or all of the four methods. Sex was not a discriminating factor in overall performance

in word recognition but there was quite conclusive evidence that the sexes differed in their aptitudes to learn by certain sensory modes of learning. (The four learning methods were almost equally effective for the girls, but the boys learned significantly better by the Auditory and Visual Methods.) There were significant differences between classes with varying lengths of school experience, particularly in aptitude to learn by the Visual and Auditory Methods. However, the pattern of scores for individual children within each sex, class, or intelligence and chronological age group, emphasizes the importance of individual differences in determining learning methods for children of this age group.

An attempt was made to secure evidence of "preferred" sensory modes of learning. The pattern of interrelationship among the tests designed to assess the various types of sensory learning gave some indication that children may have preferred senses through which they learn best. However, the problem of obtaining pure measures of each sensory mode precluded the finding of sufficient evidence upon which to base any definite conclusions.

The closer an experimental learning situation approximates that of the learning situation in the classroom the more difficult becomes the task of controlling or measuring adequately the effect of certain variables.

The limitations of research facilities and the number and complexity of the variables within: (1) the learner, (2) the materials to be learned, and (3) the methods of presentation have precluded the objective evaluation of a number of variables in the present study. However, observation of performance on the _Learning Methods Test_ has provided what may be useful information about the factors affecting word recognition for the children in this sample.

Some observations of the children's test performance.

1. Within the given time limits on the tests of recall, the children responded in one of three ways: (1) naming the word correctly, (2) giving no response, or (3) naming the word incorrectly. In analyzing the difficulties encountered by the children in word recognition, the investigator could be guided only by the errors recorded for each child. The pattern of these errors suggested that certain cues utilized by the child led to confusion of:

a) words of the same initial letters as _store_ and _sun_.

b) words of the same final letters as _baby_ and _toy_.

c) words of the same initial and the same final letters as _boy_ and _baby_.

d) words of the same general length as picture and rabbit.

e) words of the same or similar configuration as one and cow.

f) words of the same dominant detail (such as double letters) as door and school.

g) words of the same configuration and the same dominant detail as doll and ball.

h) words commonly associated as father and man.

Some errors could be due to one or more of the above sources of confusion while some could be due to other causes. There was evidence that some children resorted to guessing. It appeared that the most frequently occurring error was the confusing of words with the same initial letter. The various types of errors were evenly distributed among the methods for all children.

2. It appeared that some words might be more easily learned by one method than another. Therefore, the children's delayed recall scores for four arbitrarily selected words, varying in length and dominant detail, were examined. Because of the procedures that had been used in the original selection of the forty words to be taught to each child and in the assignment of these words to the teaching methods, the four words--pig, window, cow, and night--had not been taught an equal number of times

by each method. The number of times that each word was correctly recalled on the test of delayed recall for a specific method is shown as a percentage of the total number of times the word was taught by that method:

	pig	window	cow	night
Visual	92.3	33.3	53.3	50.0
Auditory	75.0	42.8	33.3	23.5
Kinaesthetic	50.0	26.7	40.0	16.6
Combination	72.2	31.3	50.0	21.4

The figures in the tabulation above suggest that the words pig, cow, and night were learned most easily by the Visual Method while the word window was learned most easily by the Auditory Method.

3. On the test of immediate recall some children recognized words which they failed to recognize on the test of delayed recall. These differences were termed "forgetting." An examination of the "forgetting scores" for the total sample showed that most forgetting occurred when the words were taught by the Combination Method and least forgetting occurred when the words were taught by the Visual Method.

4. On the test of delayed recall for each of the learning methods about ten per cent of the total sample recognized more words than they had recognized on the test of immediate recall. This improvement of memory between

recall tests is often referred to as "reminiscence." For individual children in this sample "reminiscence" scores ranged from one to three words.

III. LIMITATIONS OF THE STUDY

The conclusions drawn from this study must be interpreted in terms of certain limitations:

1. The study was delimited to the first-grade entrants of one large public school in the city of Saskatoon. Although this selection may have limited the socio-economic level of the sample somewhat, it included the whole population available to the investigator.

2. The necessity of maintaining a twenty-four hour interval between the teaching lesson and the delayed recall test, for each method of the <u>Learning Methods Test</u>, meant that the hour of the day, when any part of the test was administered, could not be randomized independently for each child. Thus, for some children the test had to be administered at a time of day when they may not have been at top performance level. However, it was hoped that the varied approach of the different methods and the factor of individual attention might have offset the disadvantages imposed by the schedule.

3. The schedule for the <u>Learning Methods Test</u> required that only a five-day week be utilized, in order

to teach one of the four methods each day and to administer the delayed recall test twenty-four hours after the last lesson had been taught. The intrusion of statutory holidays on two different weeks and a convention for teachers on a third week, had the effect of prolonging the experiment and giving the younger children (to whom the test was administered last) more school experience. There was some evidence, in the findings from the analysis of Classes versus Methods, that the extra school experience had given the younger children some advantage over the older children taught in the earlier part of the ten week experiment. However, some intervening variables may also have contributed to the differences between the two classes.

4. The conclusions with regard to the relative efficiency of the learning methods, for different types of children, must be limited to word recognition for the grade-one entrants of this sample and not to a wider population or to the development of reading skills in general.

5. The conclusions must be interpreted in terms of the testing instruments used in this study. There are dangers inherent in generalizing the results of this experiment to general statements about the various abilities measured.

6. In adapting the Kinaesthetic Method for use

with children at this age level (most of whom had done little writing), it was difficult to select a variety of activities. Thus, all of the activities involved tracing. However, the materials, used in the tracing, seemed to provide sufficient variety to offset any boredom or fatigue.

IV. IMPLICATIONS

In spite of the acknowledged limitations, the conclusions derived from this study do suggest certain implications.

For Teaching Methods and Materials

1. The findings, with regard to the relationship between sex and learning to recognize words by any one of the four learning methods, imply that word recognition should be differentiated for the sexes, at least for the first few months in school. It was found that, for the boys, visual and auditory methods were significantly more effective than kinaesthetic or combination methods of teaching word recognition, while the girls learned almost equally well by all methods. The following implications are suggested by these findings:

   a) That we determine which children learn best through the visual and through the

auditory modalities, teach through the stronger modality, and train the weaker sensory modality until such time as the two come more nearly into balance through maturation and/or training.

b) That, for the boys, the addition of any kinaesthetic techniques of word recognition be delayed, at least until their motor aptitudes are more fully developed. Testing at regular intervals might help to determine when, or if, kinaesthetic cues or techniques have any real value for the boys in learning to recognize words.

c) That there are few children--particularly among the boys--for whom a combined sensory approach is the most effective method of learning to recognize words.

d) That, in teaching word recognition techniques, the addition of kinaesthetic cues or techniques to the visual and/or auditory cues might be introduced much earlier for the girls. The possibility of introducing the teaching of writing, concomitantly with word recognition techniques, might profitably be investigated for girls.

2. The pattern of scores for individual children, in learning to recognize words by the four methods, implies that seldom do any two sensory modalities show the same level of development within individuals.

3. The finding of no significant relationship between chronological age and learning to recognize words implies that insofar as it concerns the teaching of word recognition--the first reading skill to be developed--grouping children by chronological age has no significant advantages. The possibility of grouping children by their most effective learning method might be investigated as a more valid criterion of readiness for reading.

4. The findings, from the analysis of Classes versus Methods, show that Class III (the younger children) were significantly better in learning to recognize words by the Visual Method than Class I (the older children). In the ten-week experiment the older children (Class I) were taught first and the youngest (Class III) last, and in the absence of any significant relationship between chronological age and learning to recognize words or of any significant differences in intelligence between the Classes I and III the findings imply that the two-month differential in school experience is responsible for the differences in learning. The relative merits of general school experience, specific visual training, or

a combination of experience and training might profitably be explored.

5. The results of the analysis of Mental Age versus Methods showed that, in general, the brighter the child, the better he was able to learn by all four methods. The implication could be that with the brighter child, as with the less able, we need: (1) to observe how, in his unique way, he combines his sensory learning modes for most efficient learning and (2) to gear his instruction in word recognition accordingly.

6. The intercorrelations of test results, the significant differences in means on tests of auditory and motor aptitudes, and the observed differences in the means of visual tests involving speed of perception and spatial orientation, suggest that the girls begin school with certain visual, auditory, and motor advantages. The implication could therefore be that these differences must be taken into account in teaching methods and materials.

7. Significant correlations were revealed between the visual and kinaesthetic methods of learning to recognize words and tests which involved both recognition and recall (as opposed to recognition alone). In both the word recognition tests and the other tests, with which they correlated significantly, integration and reorganiza-

tion of thinking were required before making a response. This would seem to imply that circling, underlining, or similar ways of identifying the correct answer, are considerably less effective learning activities than those in which the child has to write a letter, word or sentence. We might re-evaluate many of the exercises in workbooks in terms of this criterion.

8. Significant correlations were found between delayed recall of words taught by the Visual Method and performance on tests which involved holding in mind the wholeness of a figure while attending to its significant details or parts. Performance on the test of delayed recall closely resembles the task of acquiring a sight vocabulary in reading. If further research bears out these limited findings, the implication for some of our school practices seems clear. Reading readiness materials often involve only gross discrimination exercises. Although these are necessary for the child with a low level of development in visual perceptual skills, teachers should recognize the limitations of the materials, especially as they relate to the development of word recognition skills. Exercises which require finer powers of visual discrimination such as: the detection of incongruities of spelling, letter formation, or pattern; identification of indistinct representations of familiar

objects and objects enmeshed in a "busy" background (as hidden forms in a picture); picture completion or pattern copying and completion of forms by following dots or numbers. Materials that require matching of both external form and interior detail may also have merit if they involve minute discrimination.

9. The significant correlation of auditory word discrimination (as measured by the Wepman test) with learning to recognize words by an auditory method implies the importance of this auditory ability in developing word recognition by a phonic approach. The test should prove a useful diagnostic tool or test of readiness.

10. There were significant correlations found between delayed recall of words taught by the Kinaesthetic Method and performance on tests of pattern copying ability, especially those which involved figure-ground relationships. This would seem to imply: (1) that pattern copying ability might be a useful predictor of success in word recognition and (2) that writing (a form of pattern copying) might be taught concomitantly with word recognition for the improvement of both skills.

In summary form the implications for teaching methods and materials are:

1. Differentiated instruction for the sexes.

2. Identification of the individual's best

learning method, teaching by the stronger method, and training in the weaker ones.

3. Delaying kinaesthetic techniques of word recognition for boys at least until their motor aptitudes are more fully matured.

4. Earlier introduction of kinaesthetic cues of word recognition for girls.

5. Recognition that seldom do any two modalities show the same rate of development within an individual.

6. Investigation of the relative merits of learning methods grouping versus chronological age grouping.

7. Observation of how an individual combines his sensory learning modes so that his instruction may be geared accordingly.

8. Evaluation of reading readiness exercises in terms of the level and type of responses required of the child.

9. Recognition of the limitations of reading readiness materials which involve only gross visual discrimination.

<u>For Testing</u>

1. In this study the significant differences in means favoring the girls on tests of motor and auditory aptitude and the correlations of the tests of sensory learning with intelligence and chronological age have

repeatedly pointed to maturation as the main factor differentiating the performances of the boys and girls on these tests. There is an implied need for further testing, at regular intervals, to determine the developmental patterns of certain auditory and visual-motor abilities.

2. Some features of the Learning Methods Test make it a considerably more realistic predictor of beginning reading success than are many of the measures contained in some readiness tests. A study might be made with a view to developing a readiness test which incorporated the best features of this test.

For School Administration

The negligible relationship between chronological age and performance on the various tests of sensory learning would seem to imply the need for some revision in school practices where chronological age is often used as the criterion of when a child is ready to read.

V. RECOMMENDATIONS FOR FURTHER STUDY

In the completion of this study some problems have been indicated which might be explored further.

1. The relationships between auditory memory and intelligence, and auditory blending ability and intelligence, need further investigation at first-grade level.

2. The significant relationship between dot drawing and the tests of visual aptitude, motor aptitude, and recall for the Visual and Kinaesthetic Methods suggests that it may have value as a predictor of success in beginning reading. This should be investigated further.

3. There is need for further study with a view to developing a test that would help the classroom teacher identify those children who learn best through visual, auditory, kinaesthetic, or combined modes of learning. Insofar as it is possible, comparable abilities in each sensory area such as memory, discrimination, orientation and sequential patterning, should be included. Guiding principles of identification and instructional procedures need to be defined for teachers.

4. If preferred sensory modes are to be identified, there is a real need for a test which would provide relatively pure measures of auditory, visual, and kinaesthetic aptitudes. The interrelationship of these perceptual abilities should also be the subject of further study.

5. Most of the commonly used methods of teaching word recognition are multi-sensory or combined sensory approaches. A study might be designed to evaluate the effects of a multi-sensory teaching method on growth in word recognition for those children who learn significantly better through one sensory mode of learning.

6. There are many unanswered questions with regard to those children who learn significantly better through one sensory modality. Some of the problems that might be investigated are:

a) The relationship of sensory mode of learning to the differentiated development of the various perceptual skills for the sexes and within individual members of the same sex.

b) The relationship of sensory mode of learning, as measured at first-grade level, to later achievement in the skills of word recognition, silent or oral reading comprehension, and listening comprehension.

c) The relationship of cultural and experiential factors, specific training, maturation, and preferred imagery, to sensory mode of learning.

d) The implications of television teaching or of programmed learning for those children who learn best through visual, auditory, or kinaesthetic modes of learning.

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APPENDICES

APPENDIX A

RECORD FORM FOR THE LEARNING METHODS TEST

LEARNING METHODS TEST -- RECORD FORM

MILLS CENTER, INC.
1512 E. Broward Blvd.
Fort Lauderdale, Florida

Copyright, 1954

lame:__________ Date:__________ Grade__________

ex_____ Age_____ I.Q._____ Name of Intelligence Test__________

rade Level of Word-Cards Used: Primer_____ 1st_____ 2nd_____ 3rd_____

ET I. Method Used__________

	Immediate	Delayed
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
0.		
TOTALS		

SET II. Method Used__________

	Immediate	Delayed
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
TOTALS		

ET III. Method Used__________

	Immediate	Delayed
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
0.		
TOTALS		

SET IV. Method Used__________

	Immediate	Delayed
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
TOTALS		

omments:__________

xaminer:__________ Institution:__________

APPENDIX B

PINTNER-CUNNINGHAM PRIMARY TEST OF MENTAL ABILITY

[illegible]

[illegible]

Pintner-Cunningham Primary Test: Form C

Chron. Age	
Mental Age	
IQ	

By RUDOLF PINTNER, PH.D.
Formerly Professor of Educational Psychology, Teachers College, Columbia University
BESS V. CUNNINGHAM, PH.D.
Professor of Education, University of Toledo
and WALTER N. DUROST, PH.D.
Associate Professor, School of Education
Boston University

Prim.
C
(Verbal)

For Kindergarten and First and Second Grades

Name..

Age.......years.......months. Date of birth..................................

Grade...................... Teacher...

Date of test...................19.... Examiner...................................

School..

City.... ....State...

TEST	SCORE
1	
2	
3	
4	
5	
6	
7	
Total	

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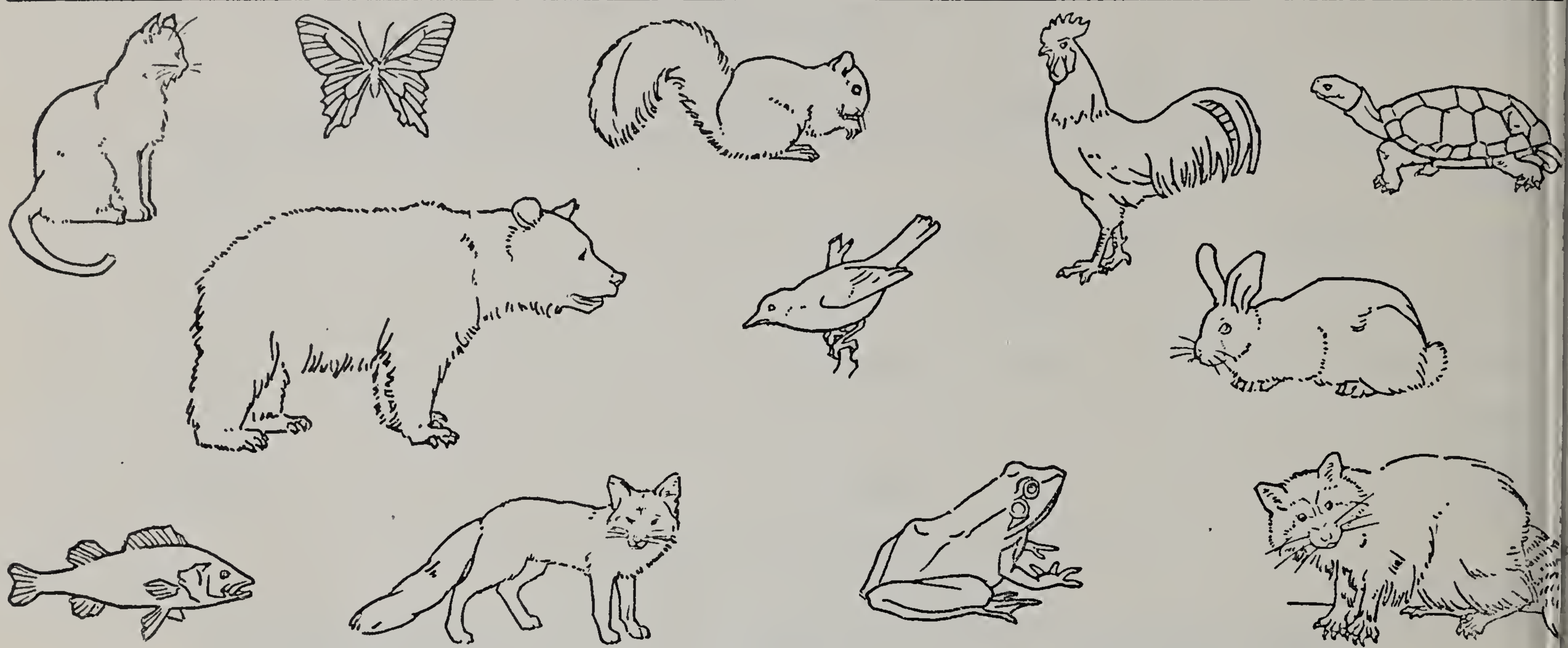

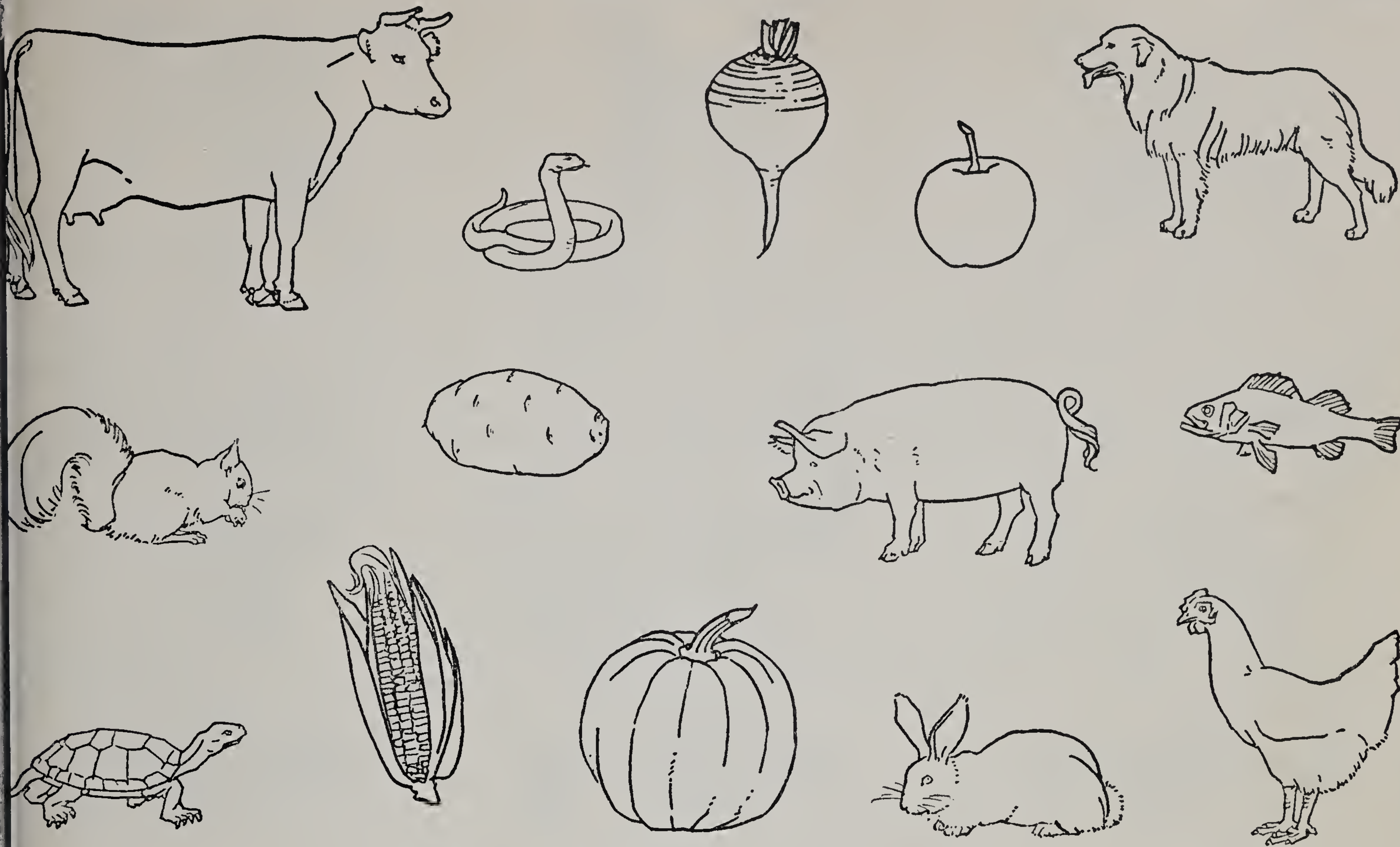

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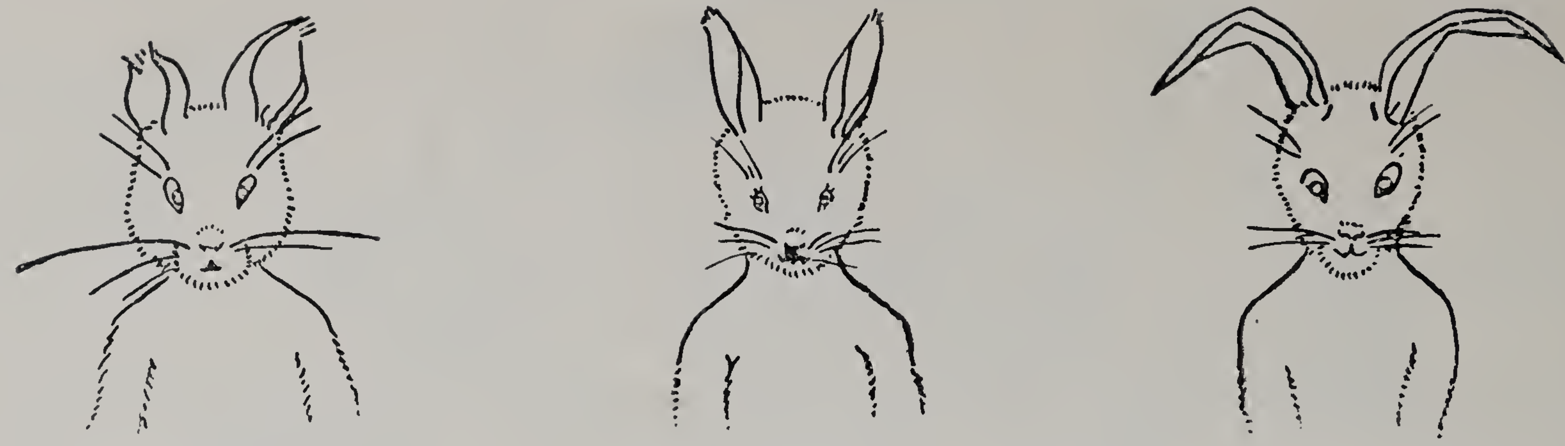
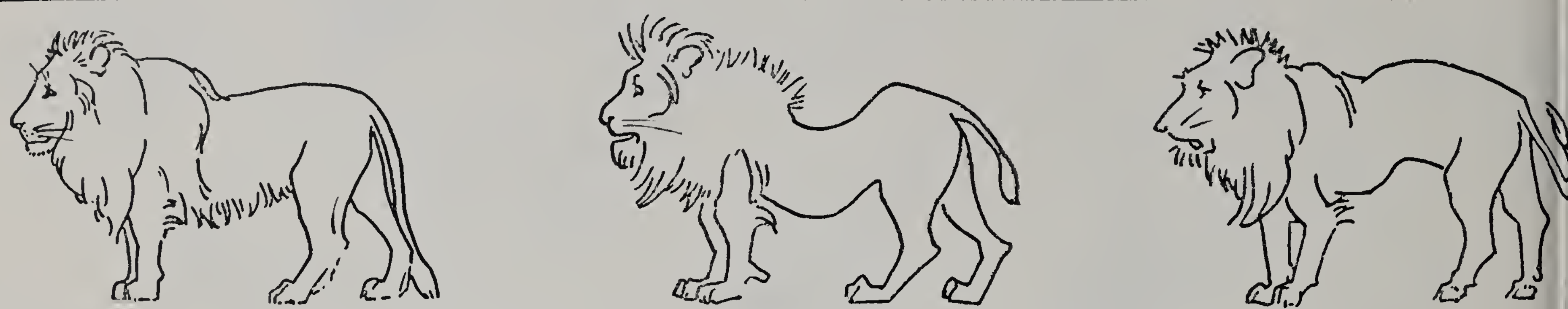
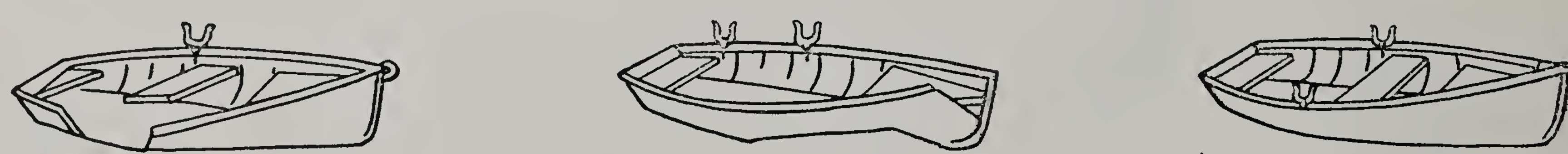
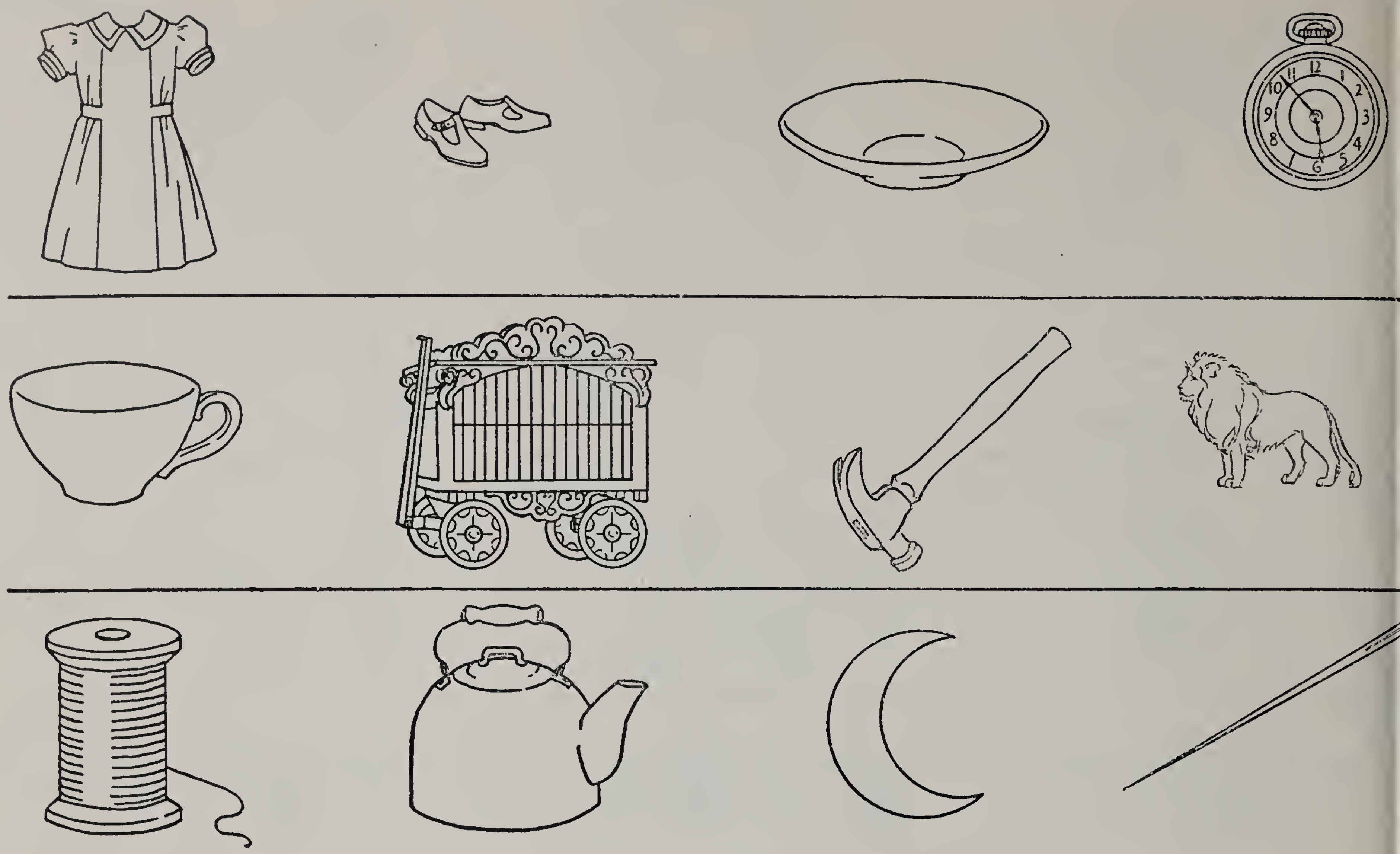


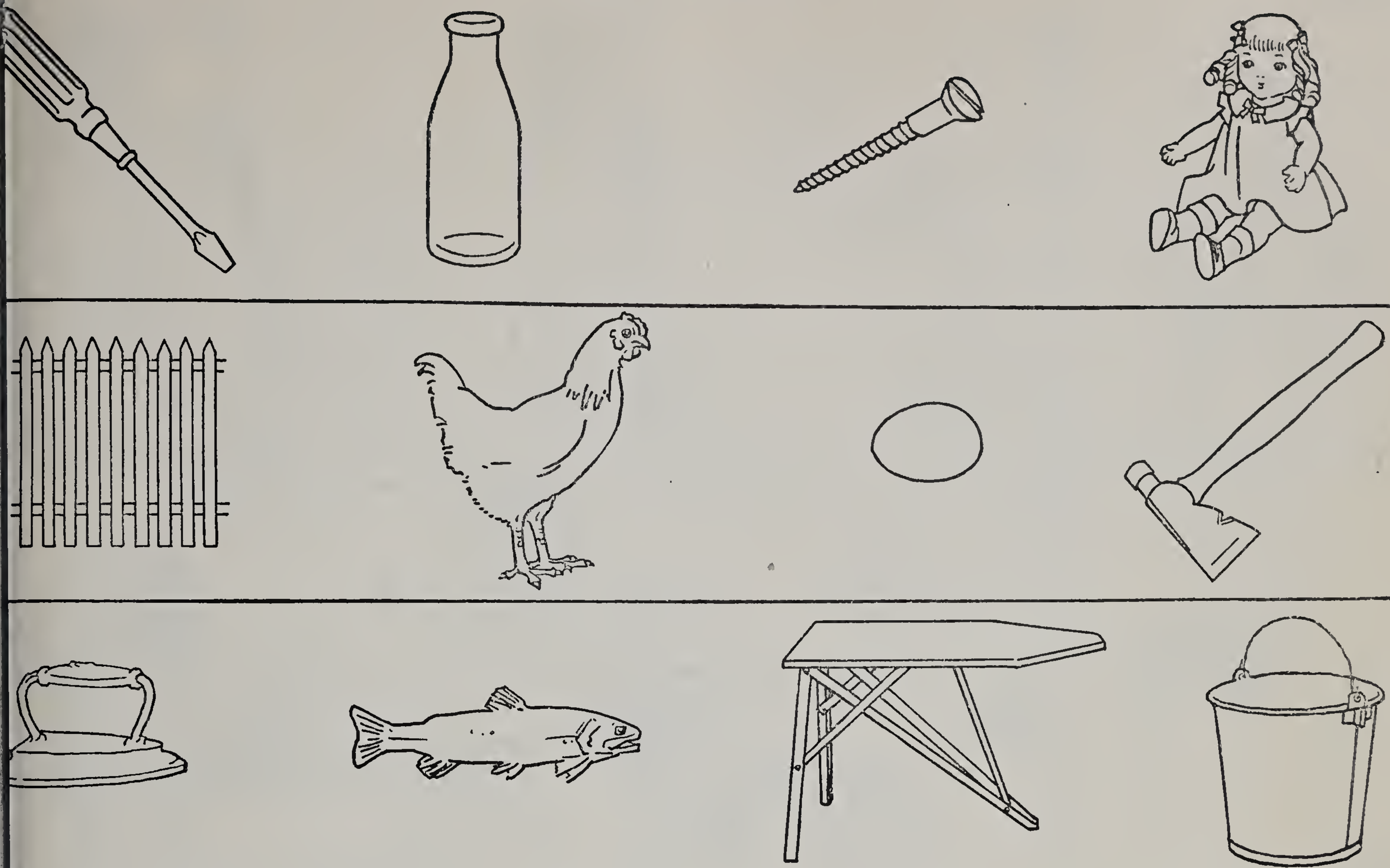




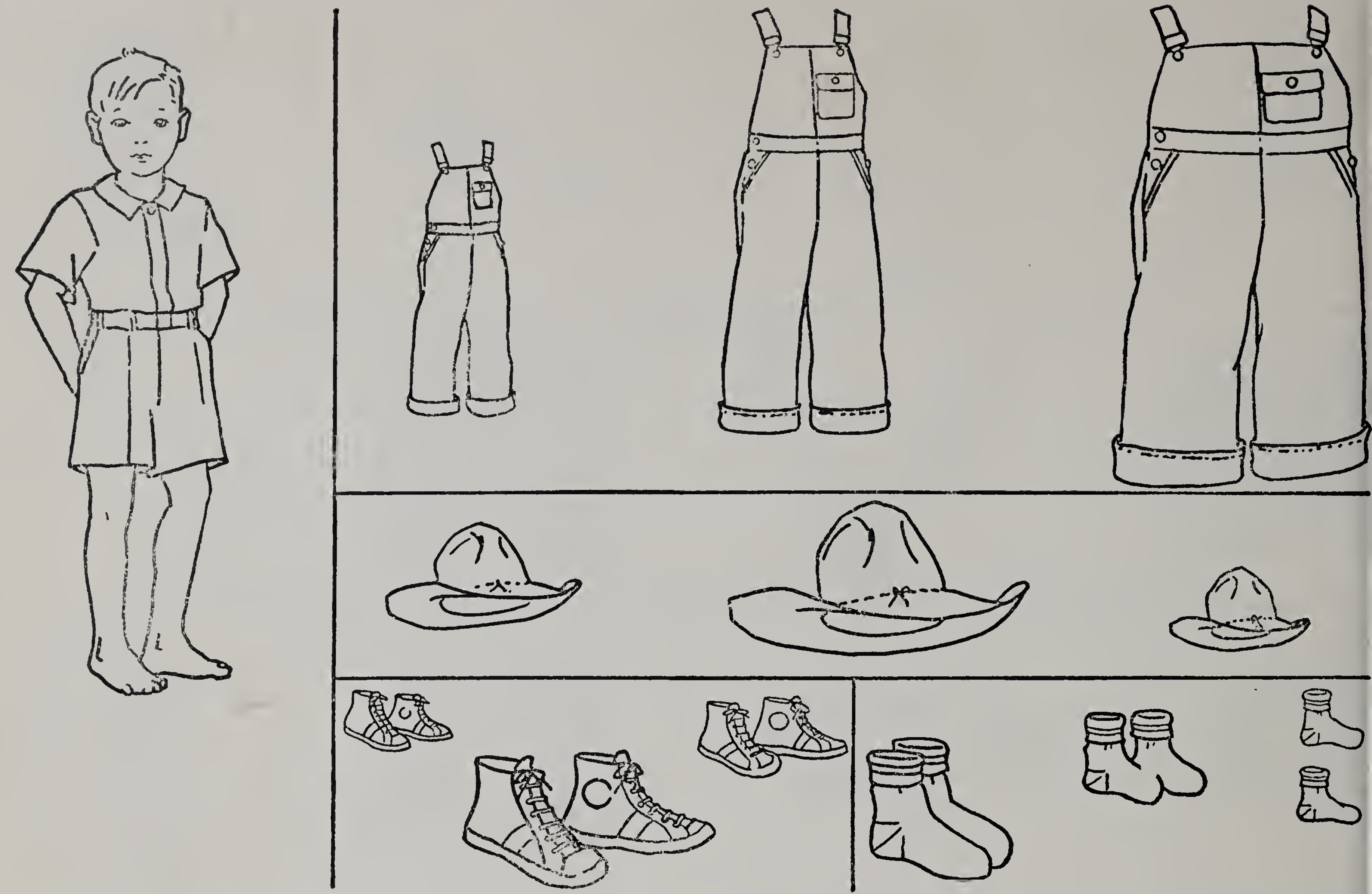
Score . . . .

TEST 3

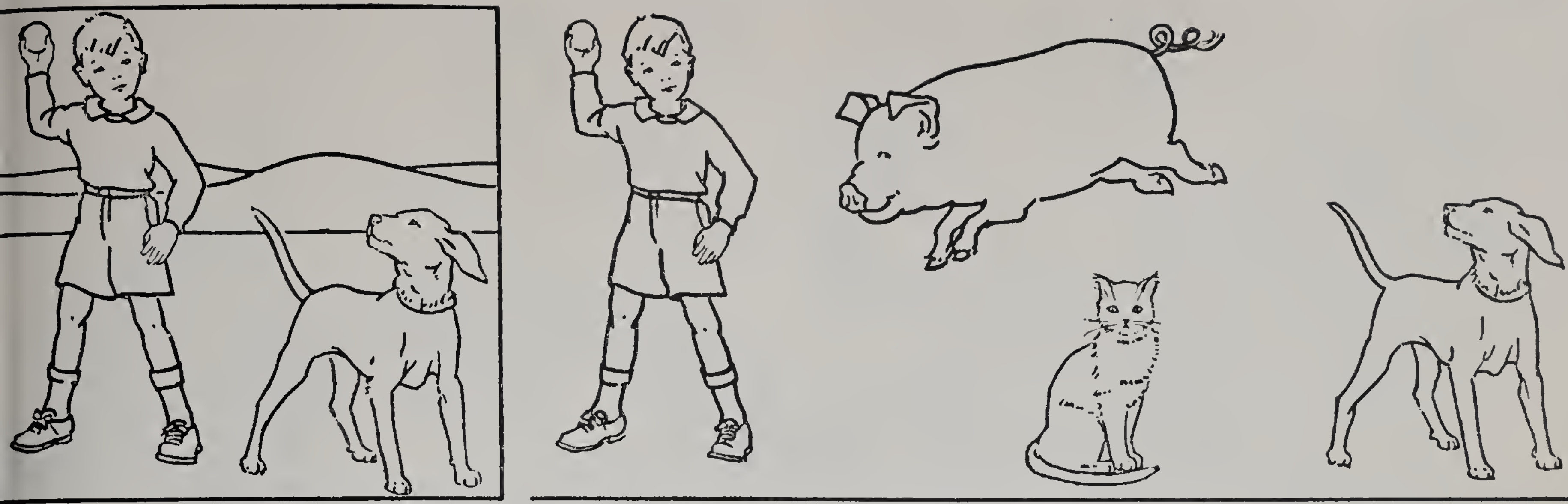


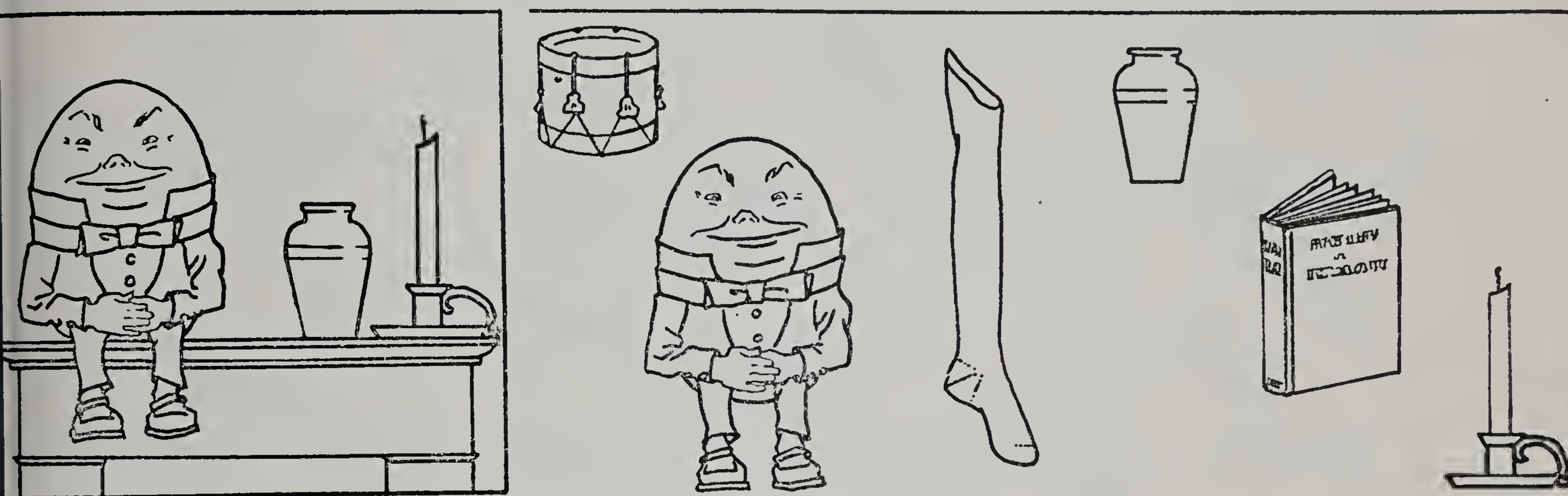


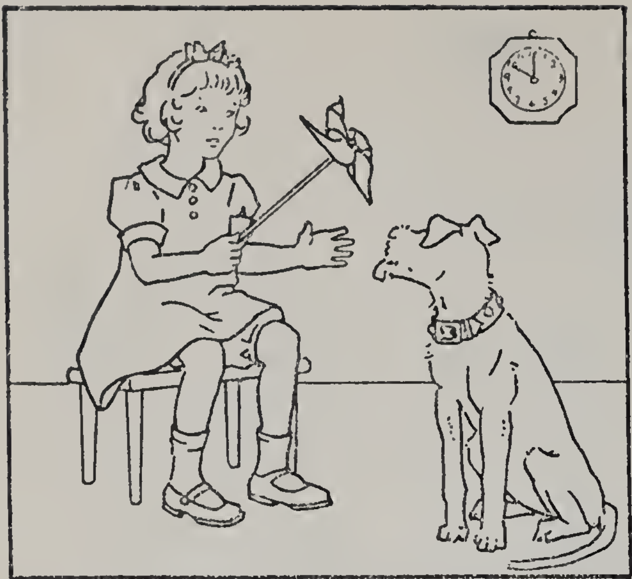
Score . . . .

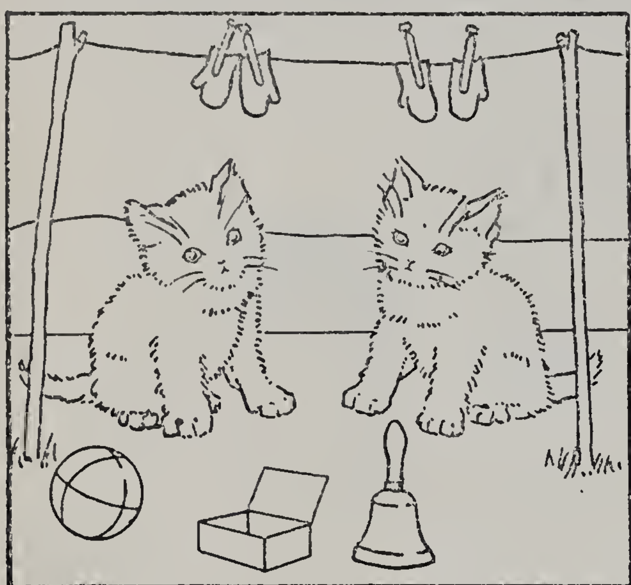


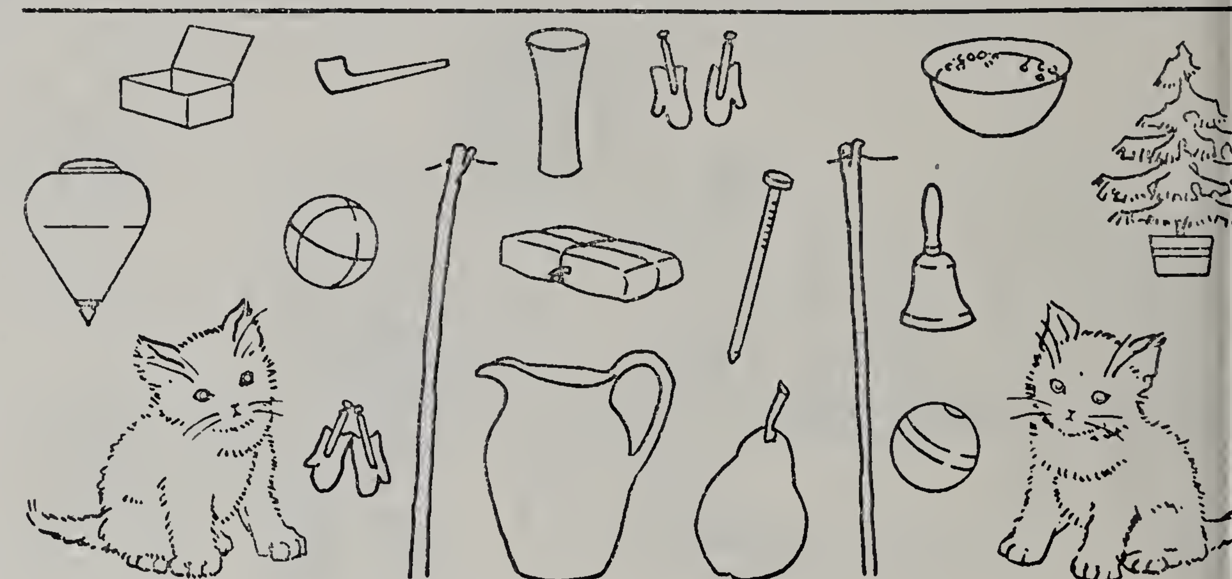
Score..........

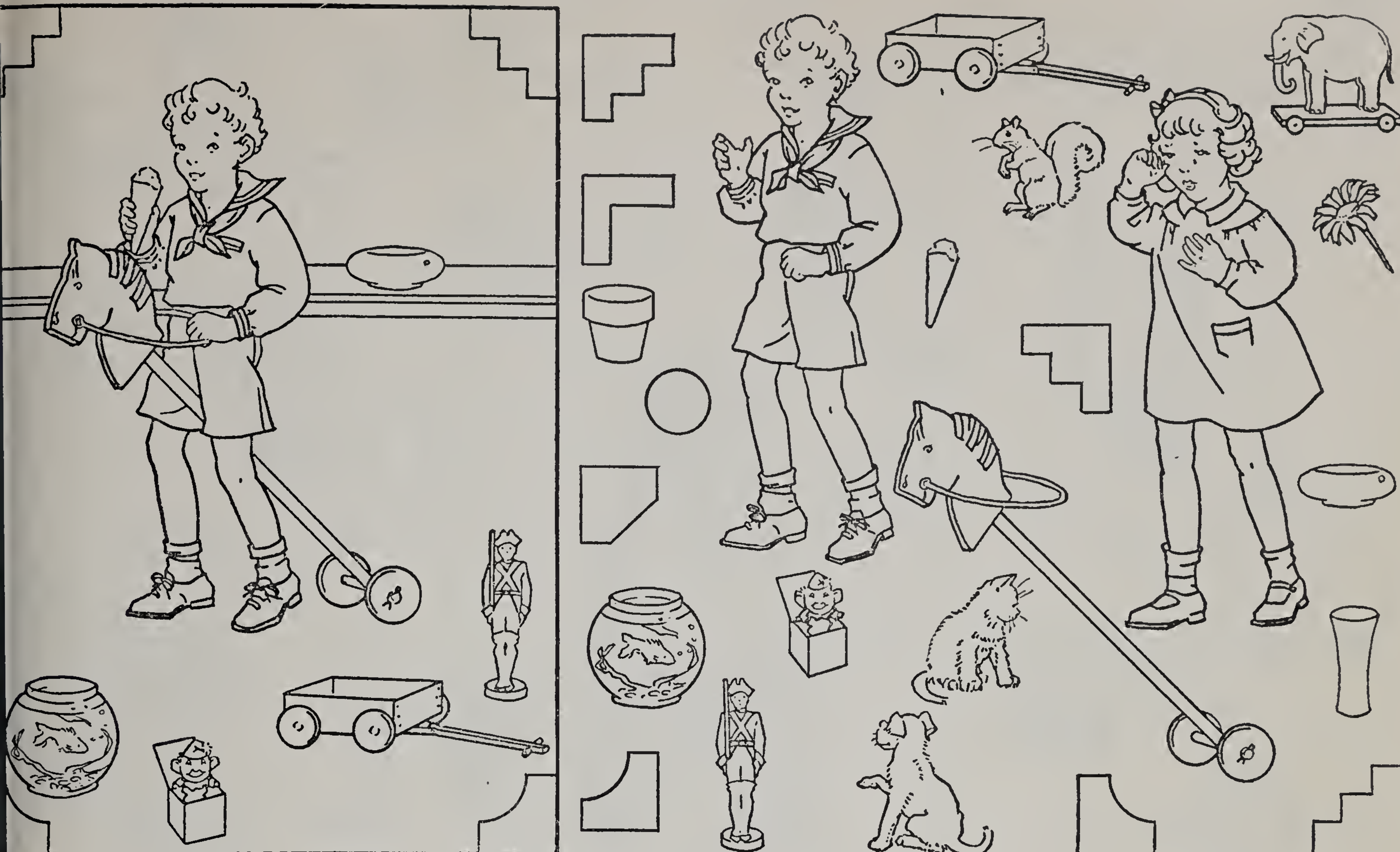




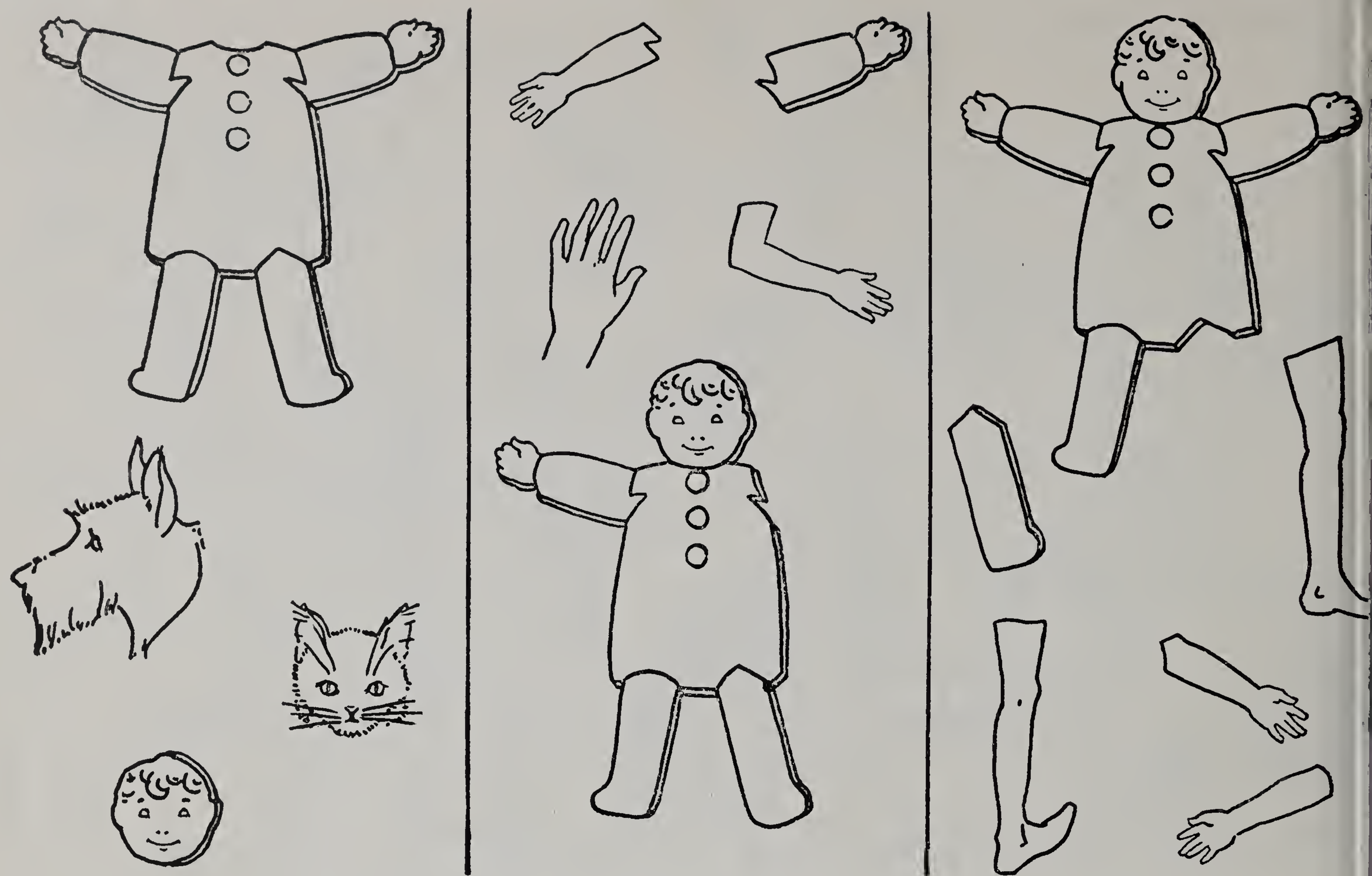


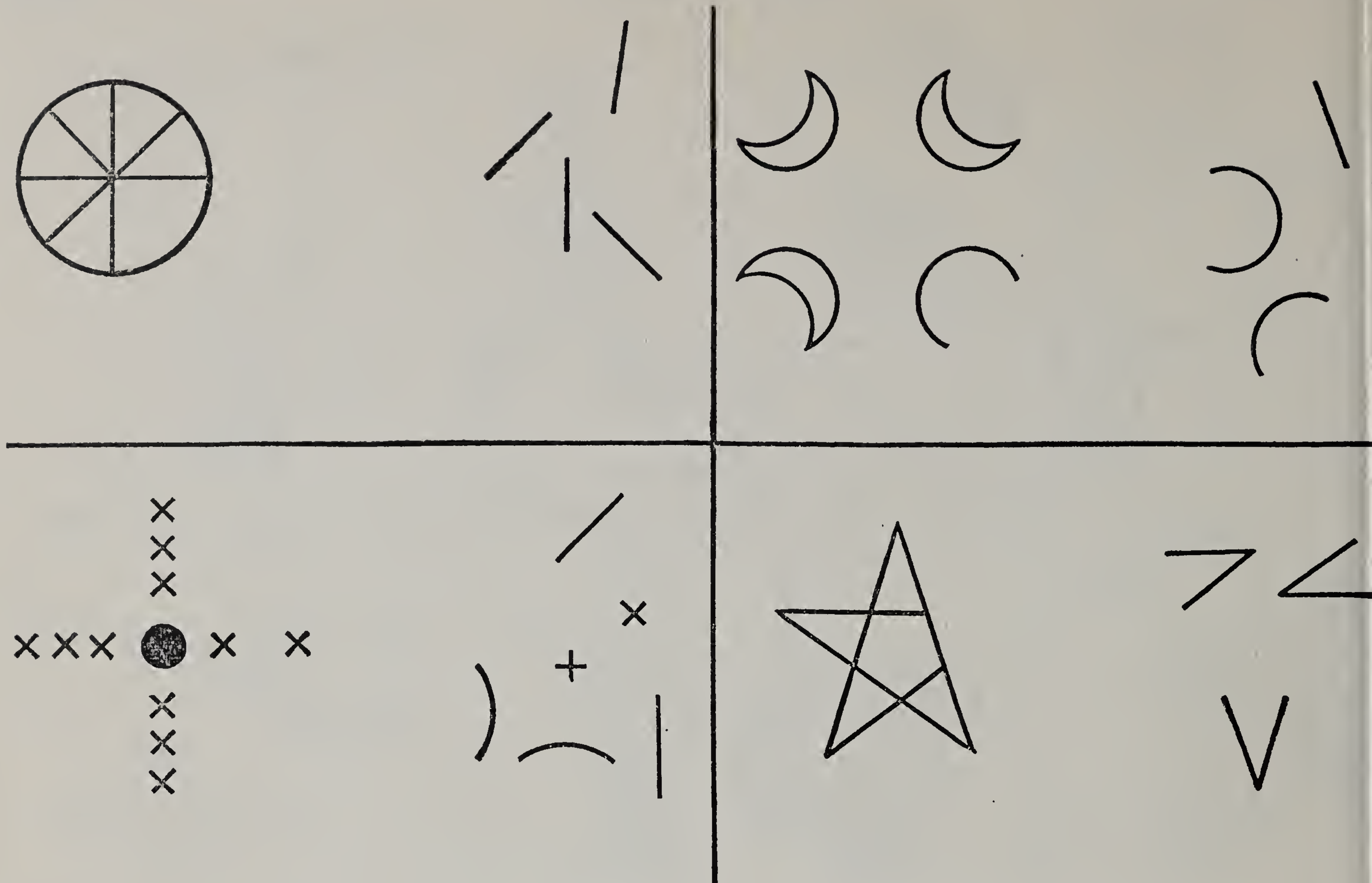




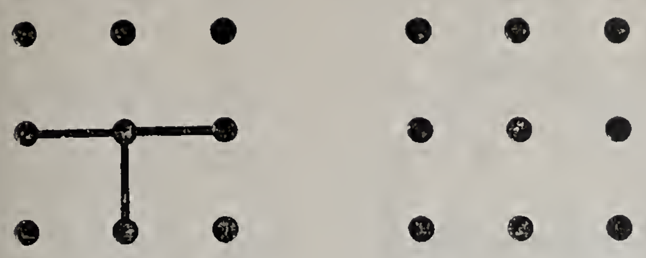


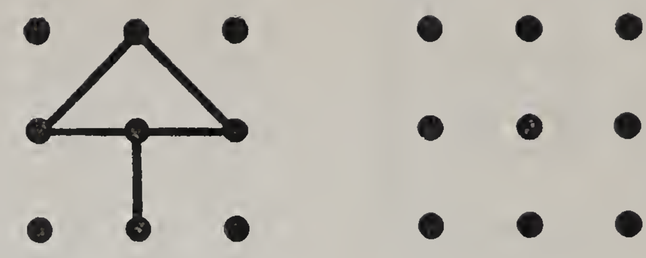
Total number right........ *Total number wrong*........ *Score* $\left(\frac{R-W}{2}\right)$..........

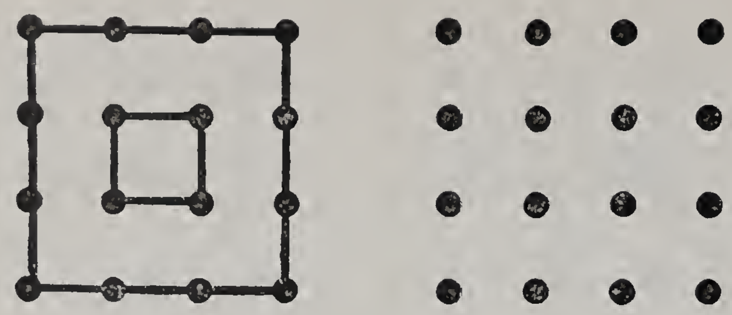


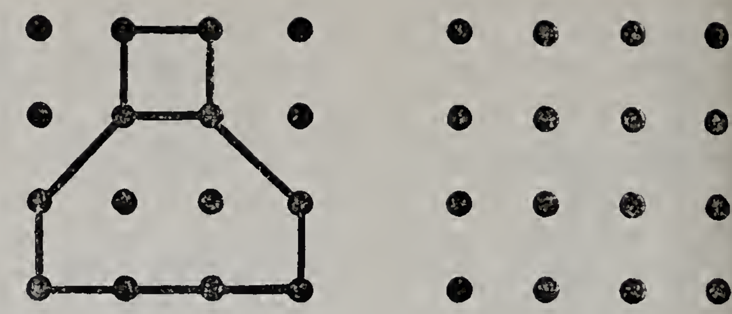


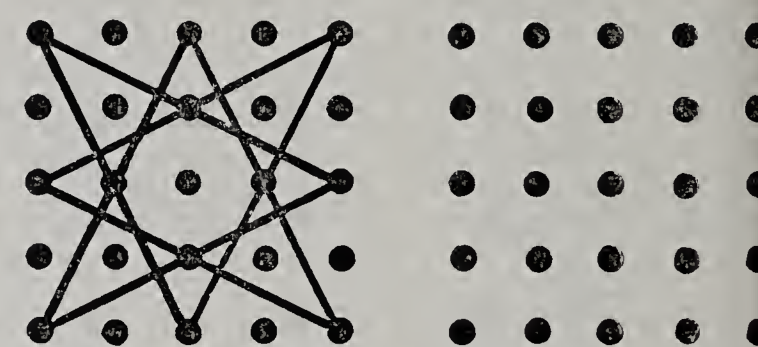
Score . . . .











Score..........

APPENDIX C

APTITUDE TESTS

WEPMAN AUDITORY DISCRIMINATION TEST

FORM A

I.

1. for - far
2. pick - tick
3. popping - potting
4. shape - shake
5. sail - sail
6. big - big
7. hunting - hunting
8. rub - rug
9. fat - fit
10. free - three
11. waiting - waking
12. met - met
13. roof - rough
14. suit - shoot
15. bedding - begging
16. lot - lock

II.

1. sit- seat
2. lake - lake
3. gaining - gaming
4. owl - hour
5. ball - ball
6. grew - drew
7. fishing - fishing
8. them - then
9. noon - none
10. man - man
11. mousing - mouthing
12. part - part
13. pen - pin
14. sing - thing
15. shaping - shaking
16. shot - shop

III.

1. noon - noon
2. fall - fall
3. fighting - fighting
4. coat - coat
5. men - man
6. red - led
7. tubbing - tugging
8. led - leg
9. bake - beak
10. told - cold
11. teething - teasing
12. pass - path
13. feed - fed
14. goat - boat
15. sharing - shelling
16. drag - drag

IV.

1. hid - hid
2. keep - peep
3. running - running
4. half - hath
5. gas - geese
6. sand - sand
7. huffing - hushing
8. puss - push
9. neat - neat
10. moon - noon
11. lacking - lacking
12. lead - lead
13. two - tea
14. watt - yacht
15. betting - betting
16. chop - chop

NAME . . . . DATE . . . .

GRADE . . . . . . SEX . . . . . . I.Q. . . . . . SCORE . . . .

Primary Form

READING APTITUDE TESTS

For Prediction and Analysis of
Reading Abilities and Disabilities

BY MARION MONROE

FORMERLY SPECIALIST IN REMEDIAL INSTRUCTION, PITTSBURGH PUBLIC SCHOOLS

Name.................................Birthdate................Age............Date.............

Grade...............School..........................Intelligence Test..............I. Q............

Summary of Scores:

VISUAL 1.....
2.....
3.....Total.....Percentile.....

AUDITORY 1.....
2.....
3.....Total.....Percentile.....

MOTOR 1.....
2.....
3.....Total.....Percentile.....

ARTICULATION 1.....
2.....Total.....Percentile.....

LANGUAGE 1.....
2.....
3.....Total.....Percentile.....

Average Percentile.....

PROFILE OF ABILITIES

Percentiles	I. Q.	Visual	Auditory	Motor	Articulation	Language	Average Percentiles
100							
90							
80							
70							
60							
50							
40							
30							
20							
10							
0							

Hand Preference.....R.....L
Eye Preference.....R.....L
Foot Preference.....R.....L
Total.....R.....L

READING APTITUDE.........................

Visual defect..............................
Hearing defect............................
Speech defect..............................
Physical defect............................
Foreign language..........................

Comments:

....
....
....
....

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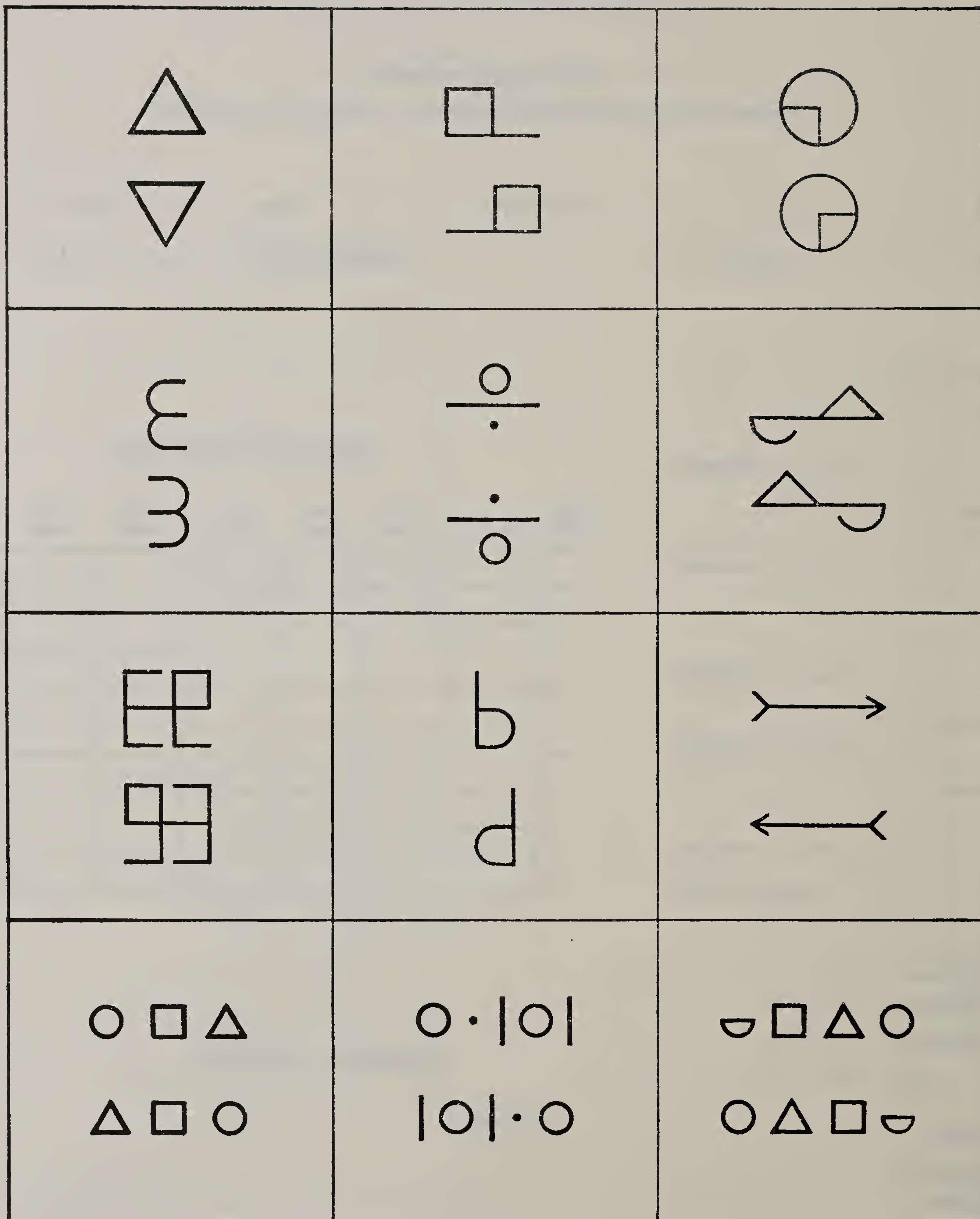
GROUP TESTS

Visual Test 1

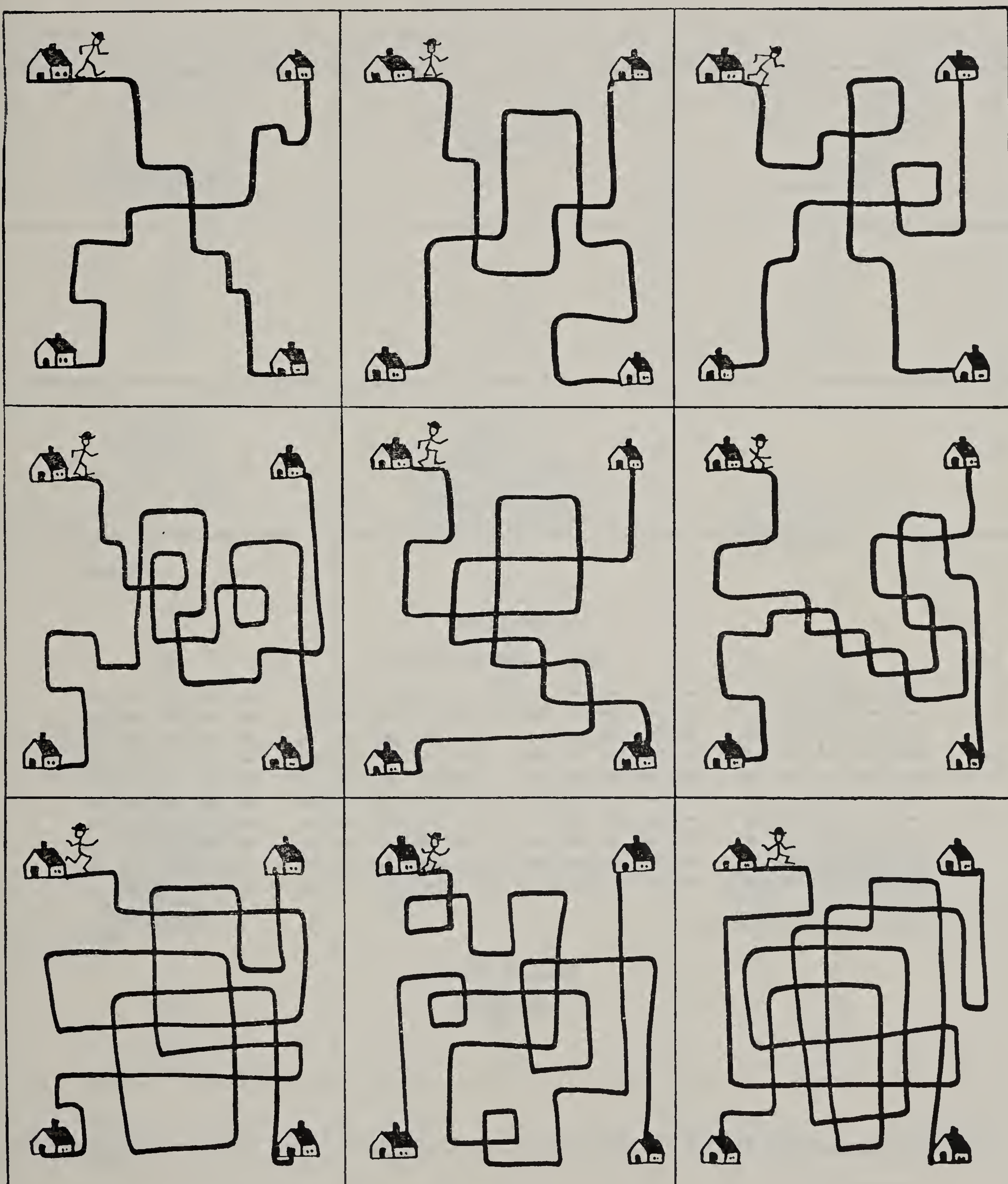
Memory of Orientation of Forms



Score. . . . .

Visual Test 2

Ocular-Motor Control and Attention



Score............

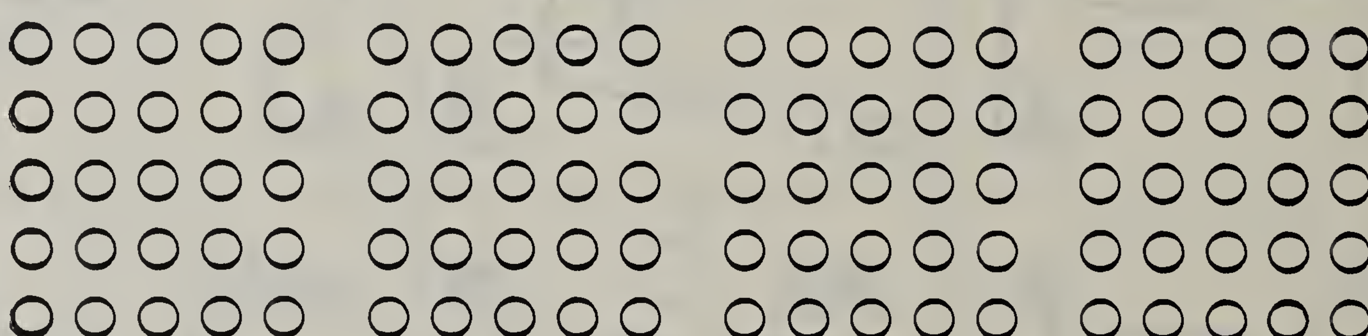
Visual Test 3

Memory (*Expose cards 10 seconds*)

Score..........

Motor Test 1

Speed (*Allow 60 seconds*)



Score..........

Motor Test 2

Steadiness

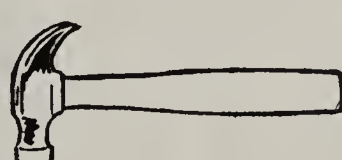
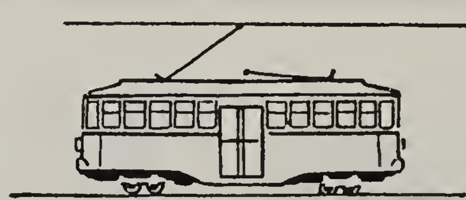
Score..........

Score..........

Average Score..........

Auditory Test 1

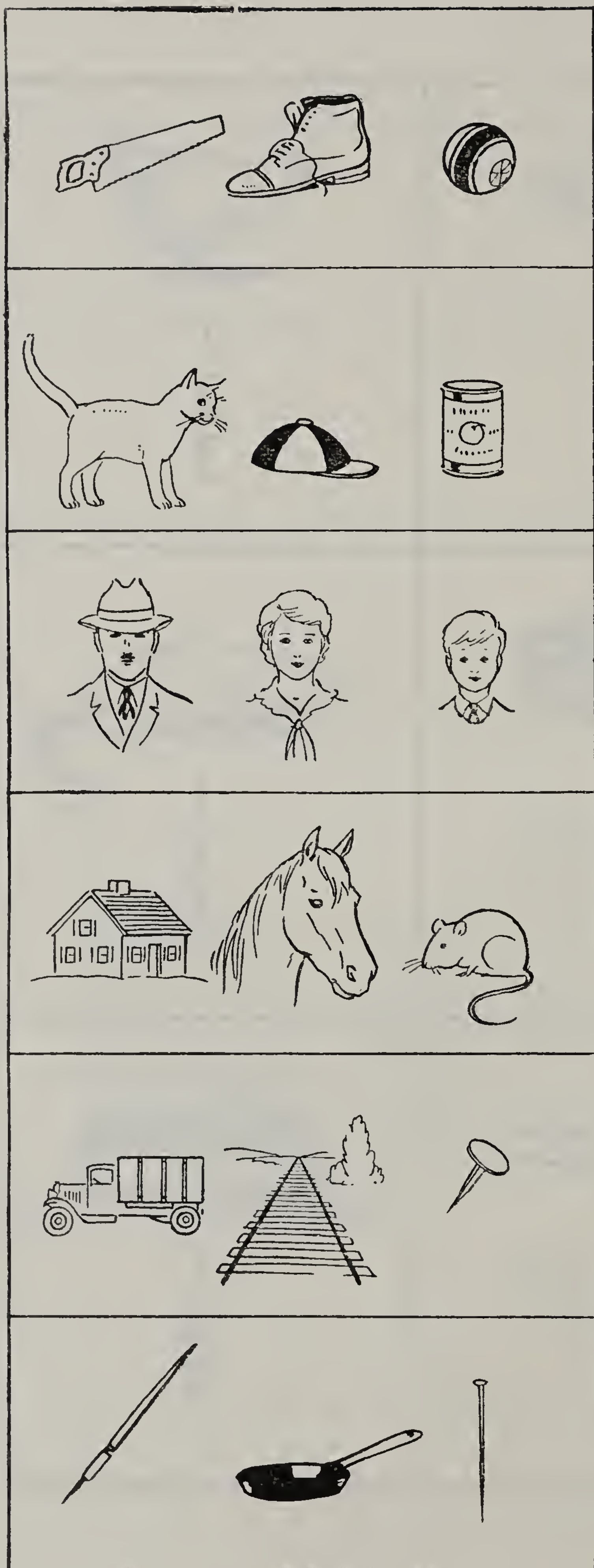
Word - discrimination

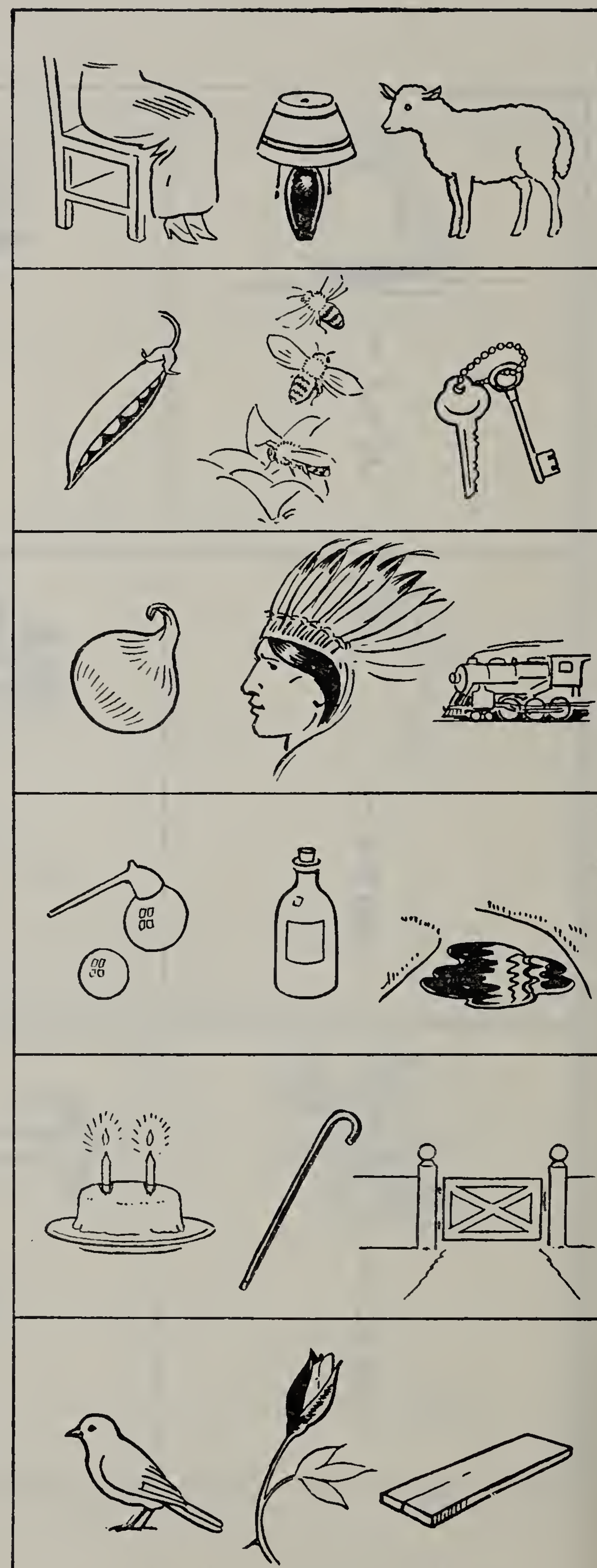
 1 2 3	 1 2 3	 1 2 3
 1 2 3	 1 2 3	 1 2 3
 1 2 3	 1 2 3	 1 2 3

Score.........

Auditory Test 2

Sound - blending

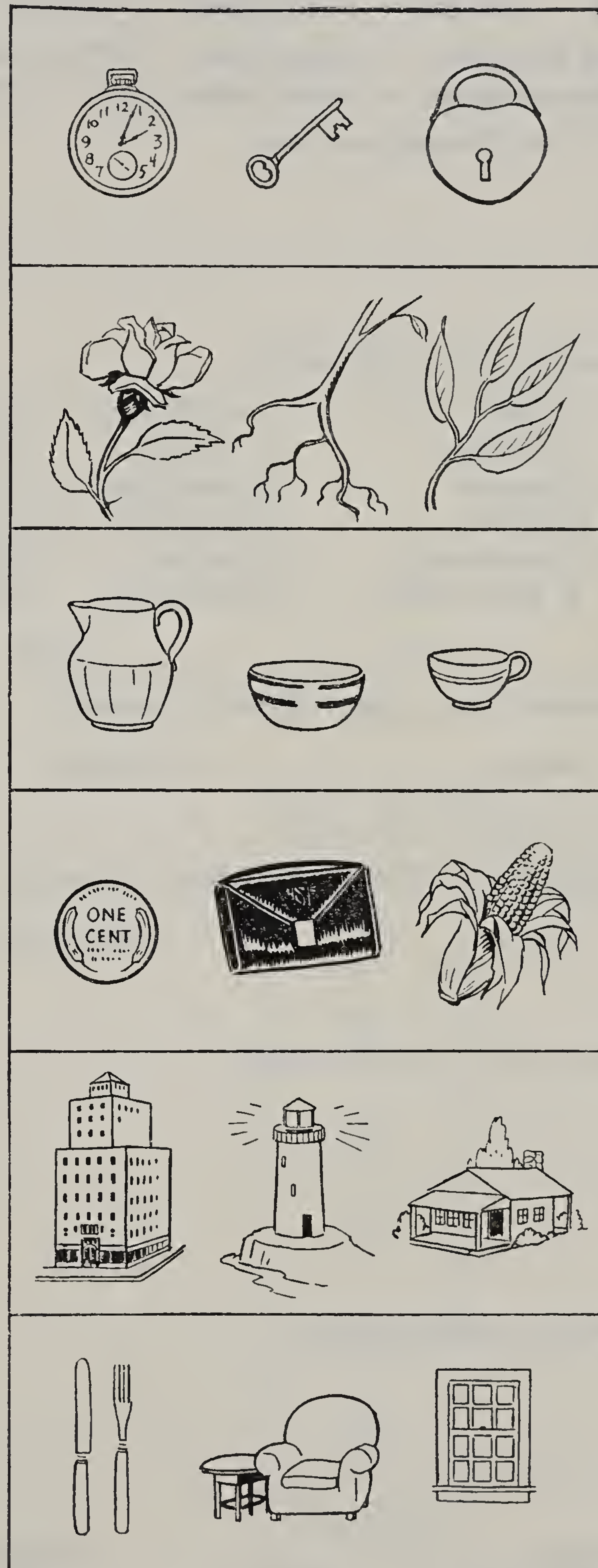




Score..........

Language Test 1

Vocabulary



Score............

INDIVIDUAL TESTS

Auditory Test 3, Auditory Memory

A mother hen — had three — baby chicks. — Their names were Scratchy — Patchy — and Chick-Chick. — One day — the chickens — went for a walk — in Farmer Joe's — garden. — They were having a fine time — eating lettuce — when a big dog — ran toward them — barking loudly. — The chickens ran home — as fast as they could, — all except little Chick-Chick — who hid — behind a big leaf — until the dog went away.

....

....Score........

Articulation Test 1, Reproduction

1. baby
2. tick tock
3. see saw
4. so busy
5. run around
6. what weather
7. this thumb
8. very fine
9. green glass
10. sly sister
11. few flew
12. quite white
13. quick kick
14. pink pig
15. big bag beg
16. come cub cup
17. she sells silk
18. try three threads
19. stop Sam's sled
20. pick peck pack
21. Bobby's better blotter
22. mythological
23. incomprehensibility
24. transcontinental

Score...........

Articulation Test 2, Speed (Allow 15 seconds)

banana........................long ago......................take a bite.......................

Score...........

Language Test 2, Classification (Allow 30 seconds)

animals.......................things to eat.......................toys.......................

Score...........

Language Test 3, Sentence-Length

....

....

....Score...........

Motor Test 3, Writing Name

....

....Score...........

Handedness:

Writing	R L	Needle	R L
Throwing	R L	Winding	R L
Combing hair	R L	Fold hands	R L
Batting	R L	Fold arms	R L

Eyedness:

Cone	R L	R L	R L
Cardboard	R L	R L	R L

Footedness:

Hopping	R L
Kicking	R L
Climbing	R L

Visual Discrimination Tests

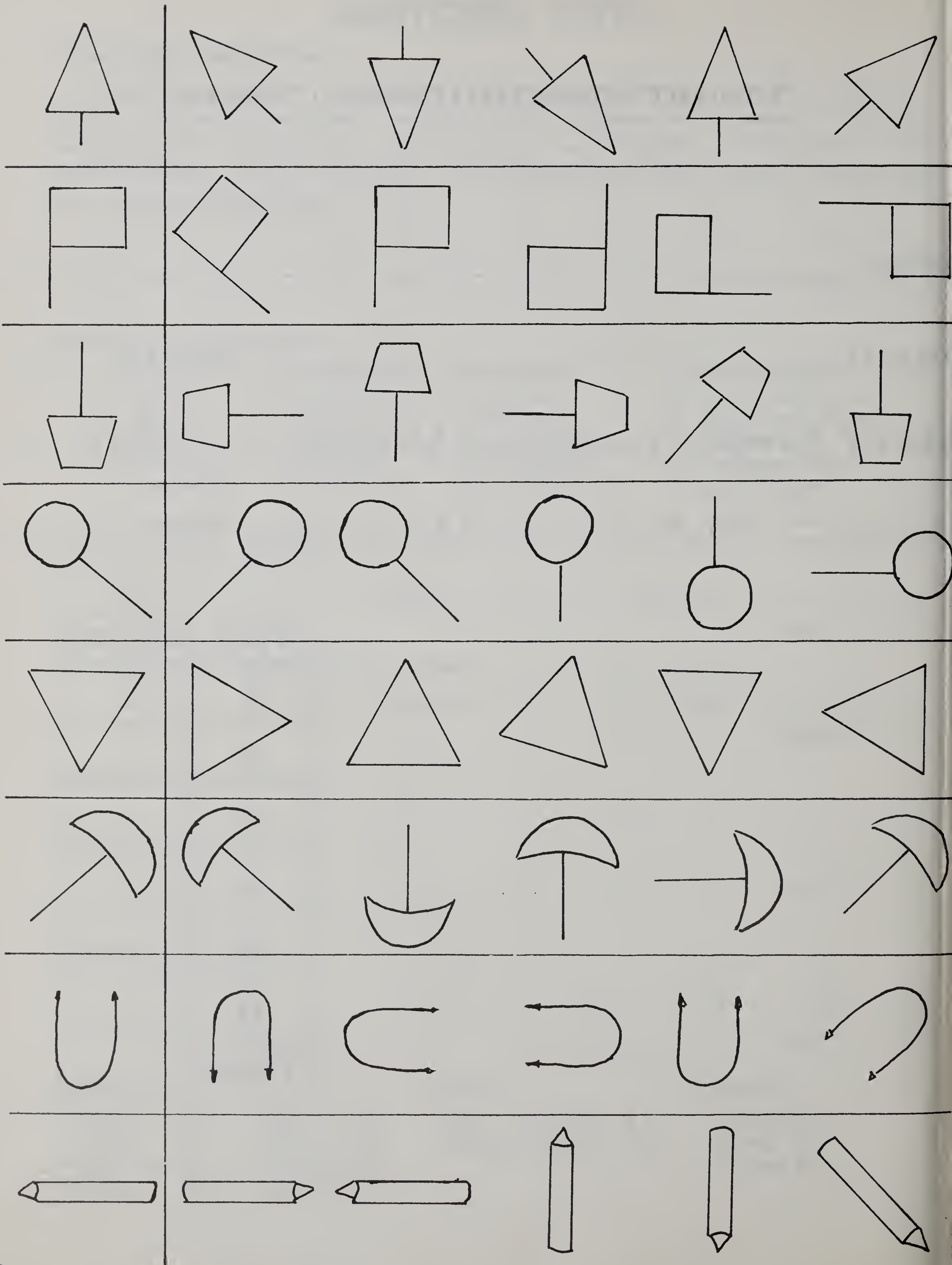
ame ____

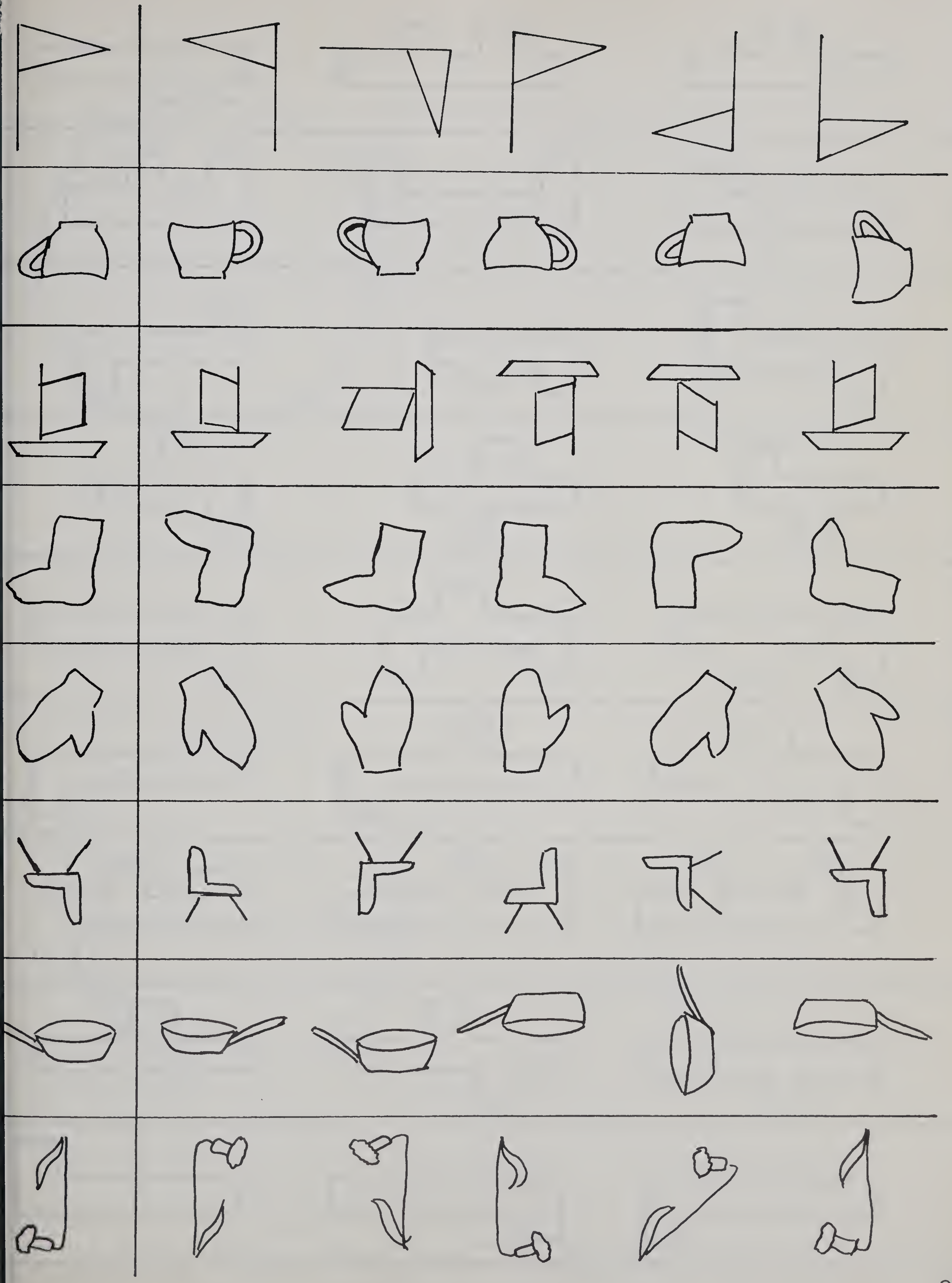
chool ______________________________ Room ______

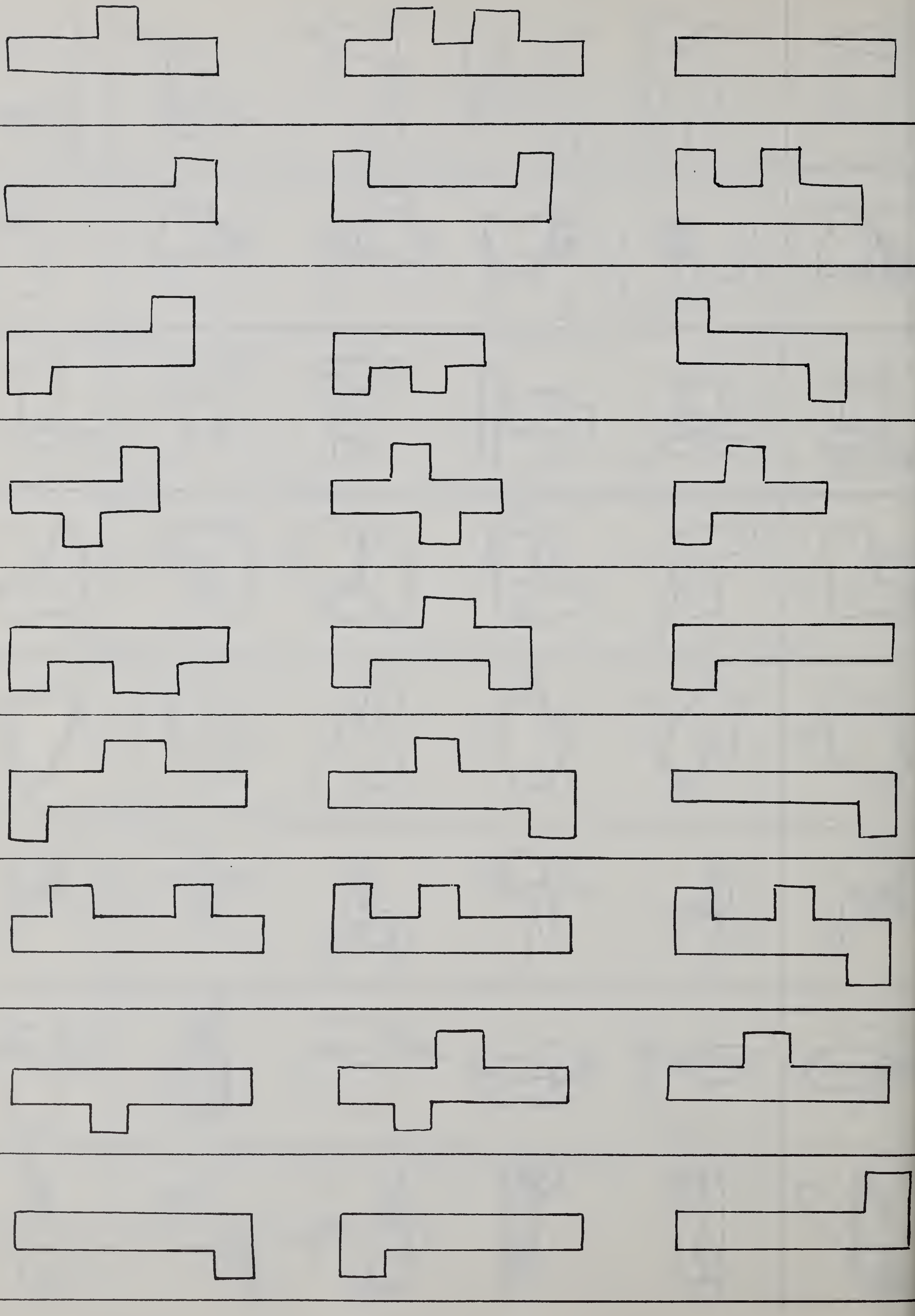
ate of birth __ Year ______ Month ______ Day ______

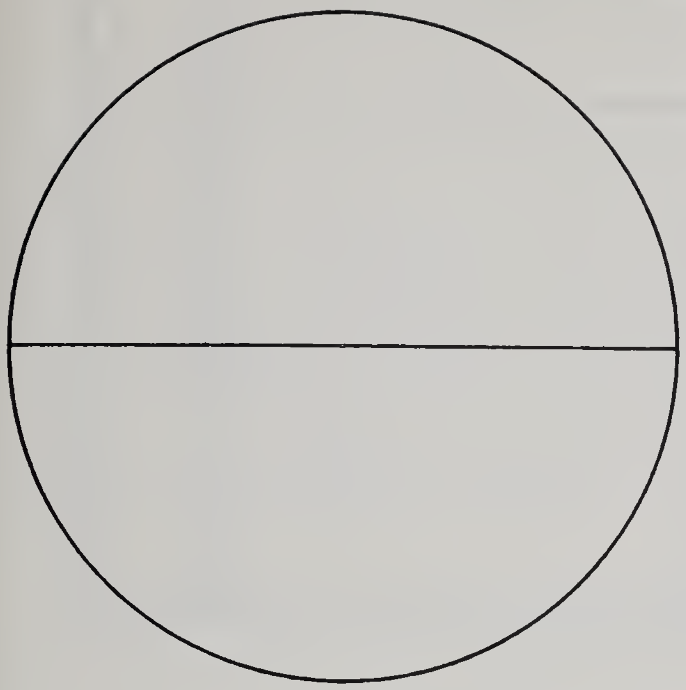
A. ________ M.A. ________ I.Q. ________ Sex ________

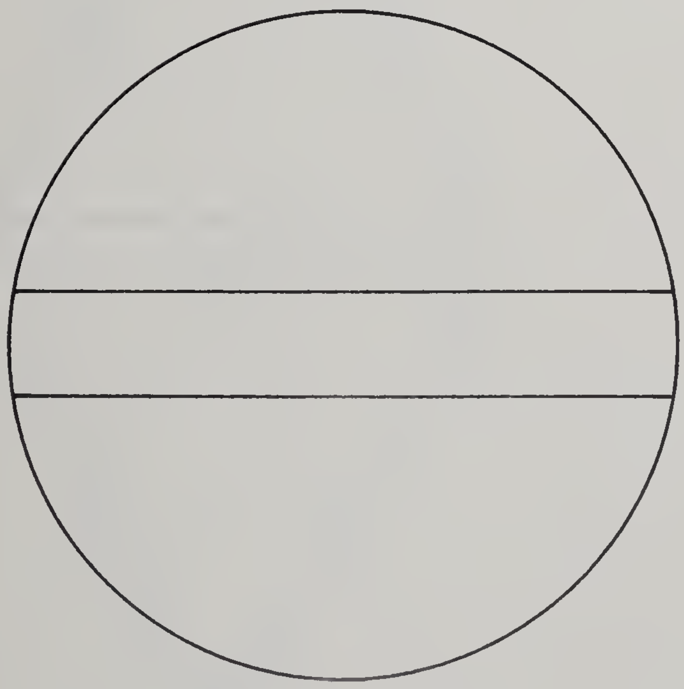
Test	Score
1	
2	
3	
4	
5	
6	
Total	

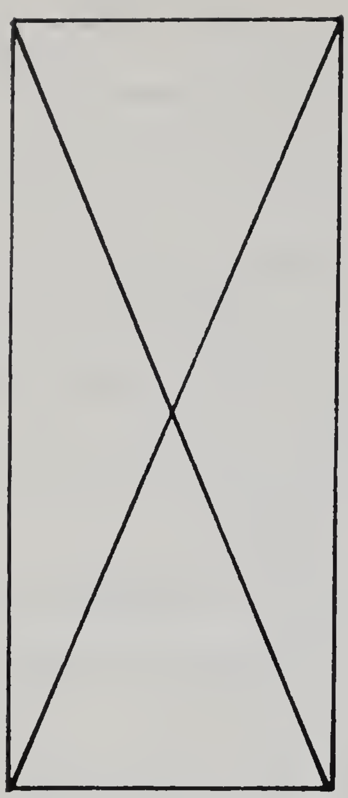


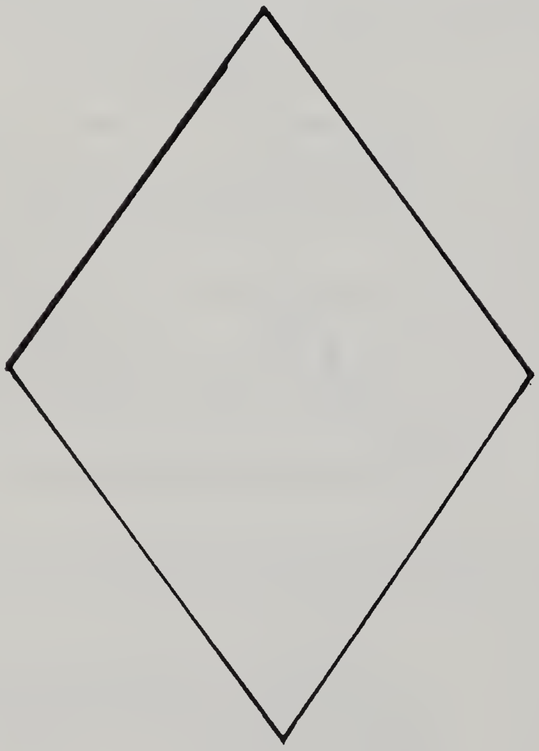


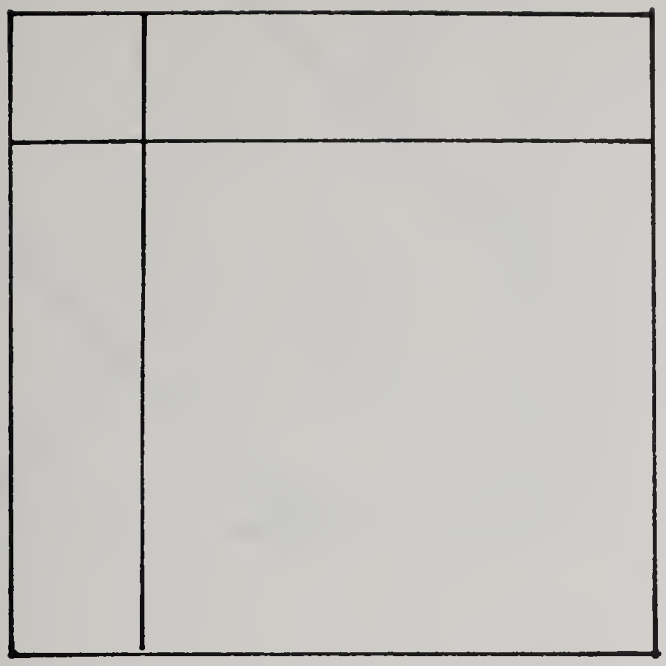


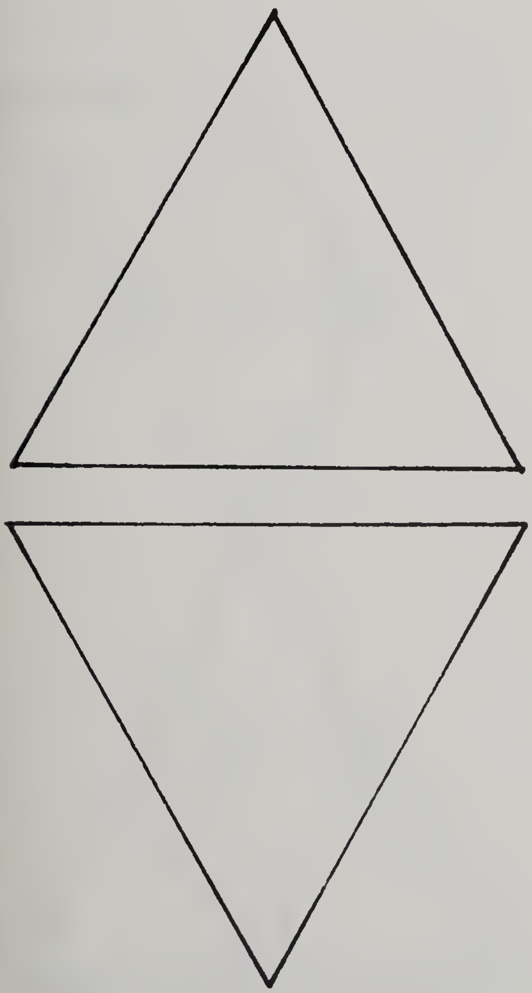


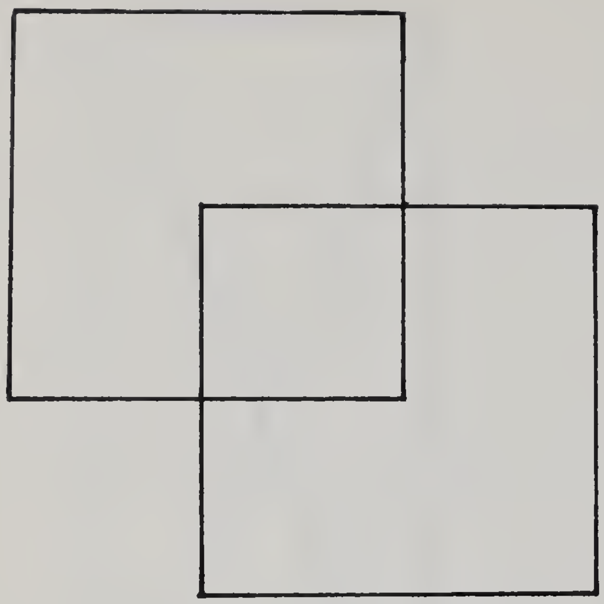


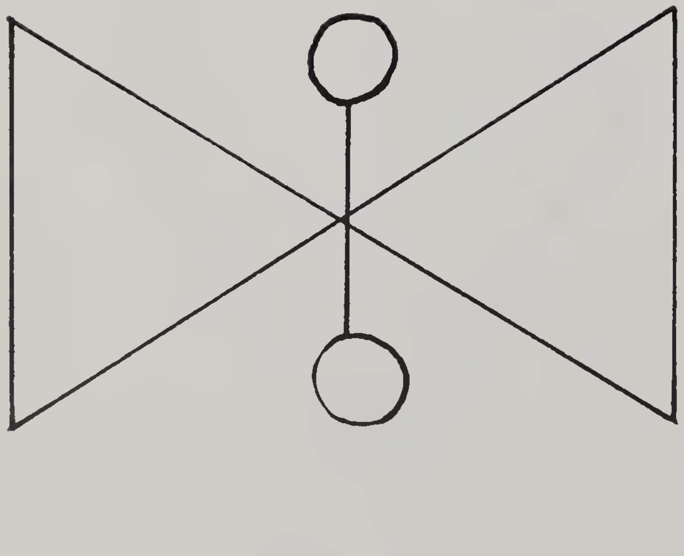


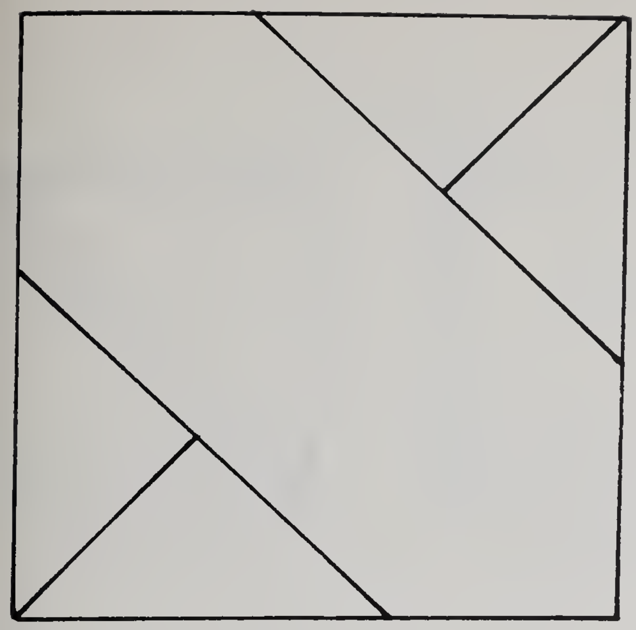


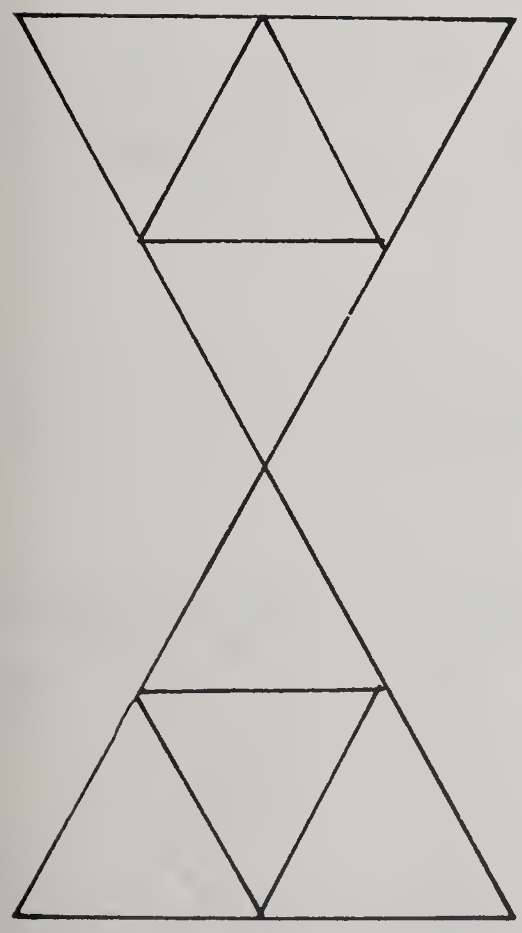


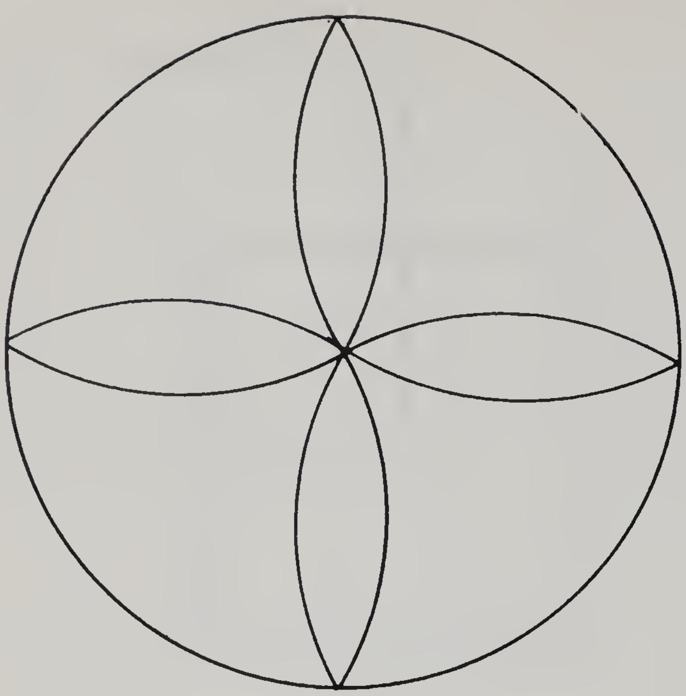


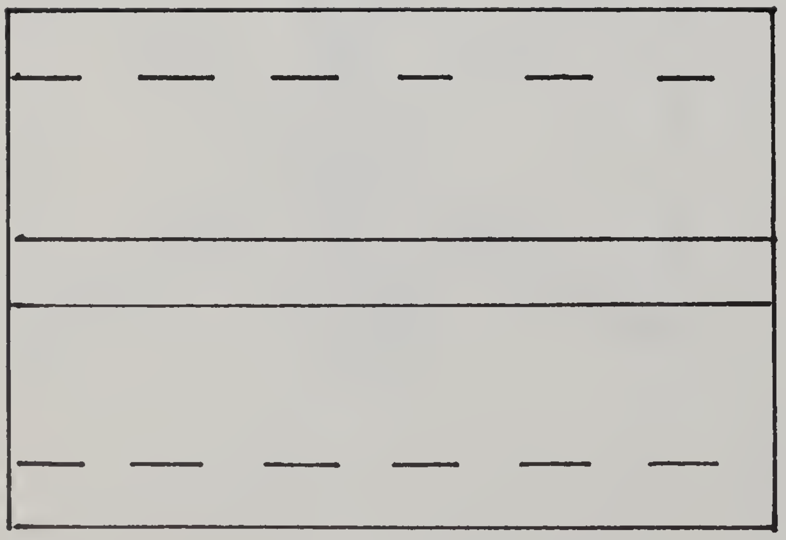


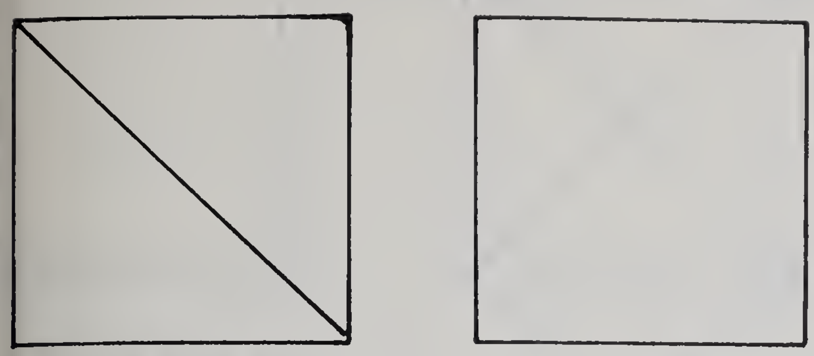


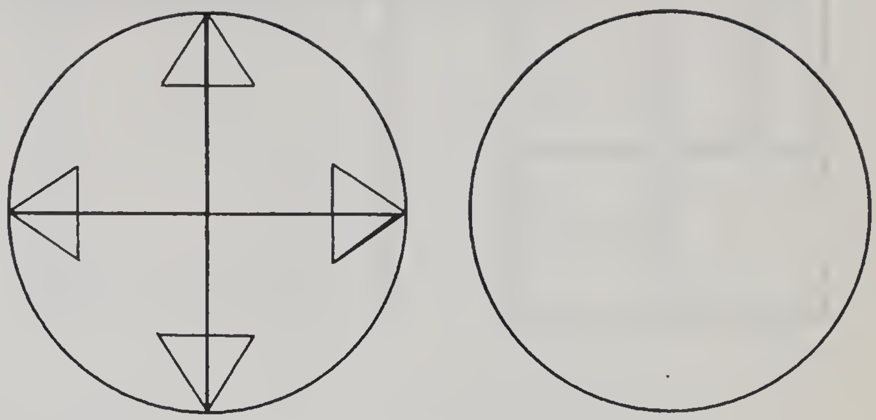


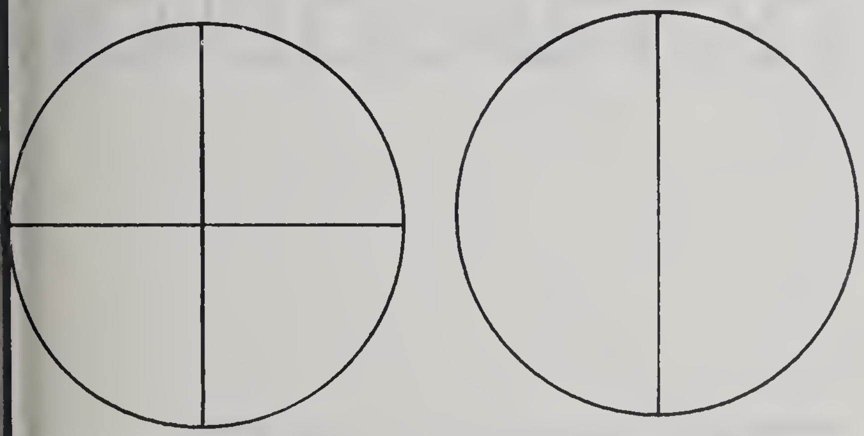


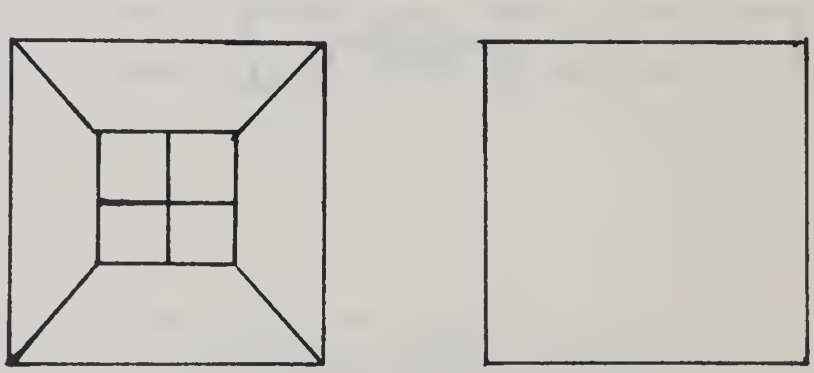


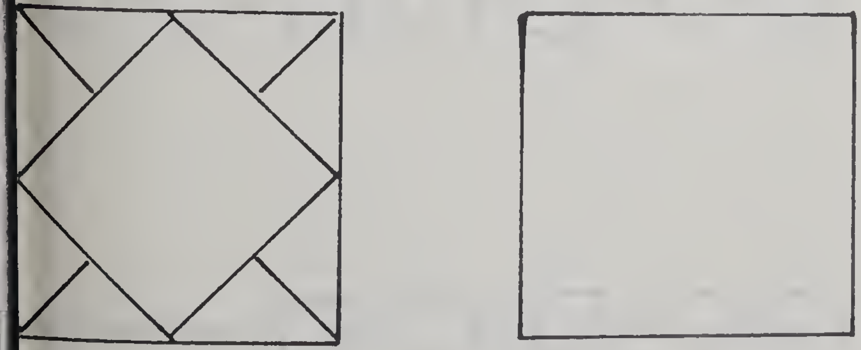


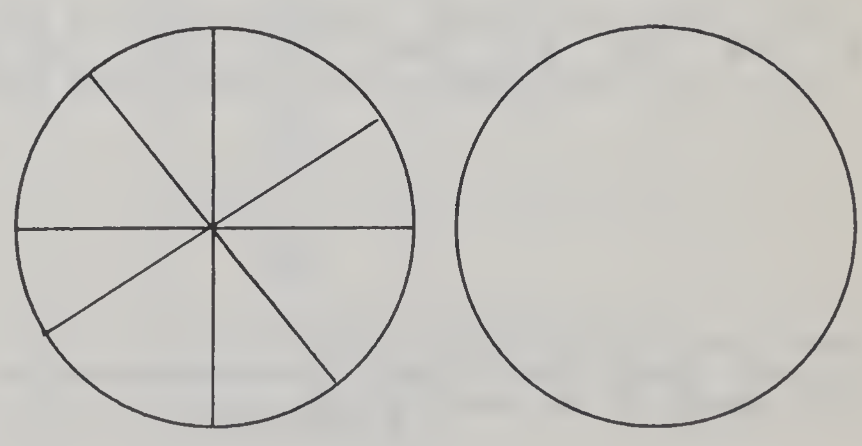


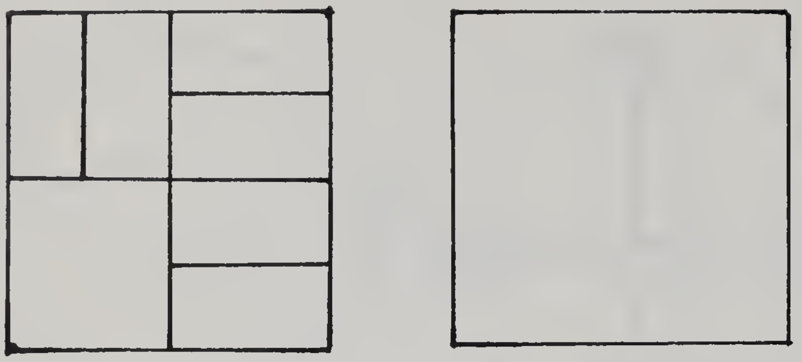


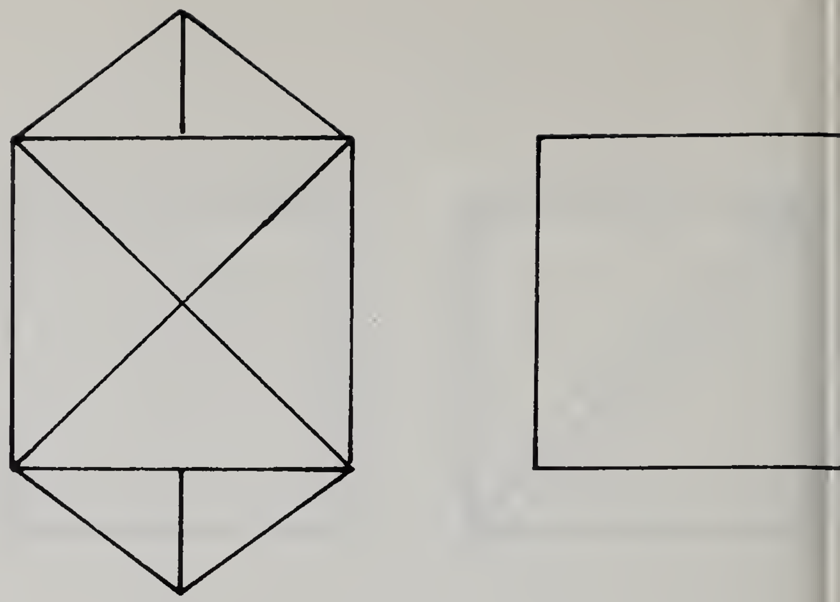


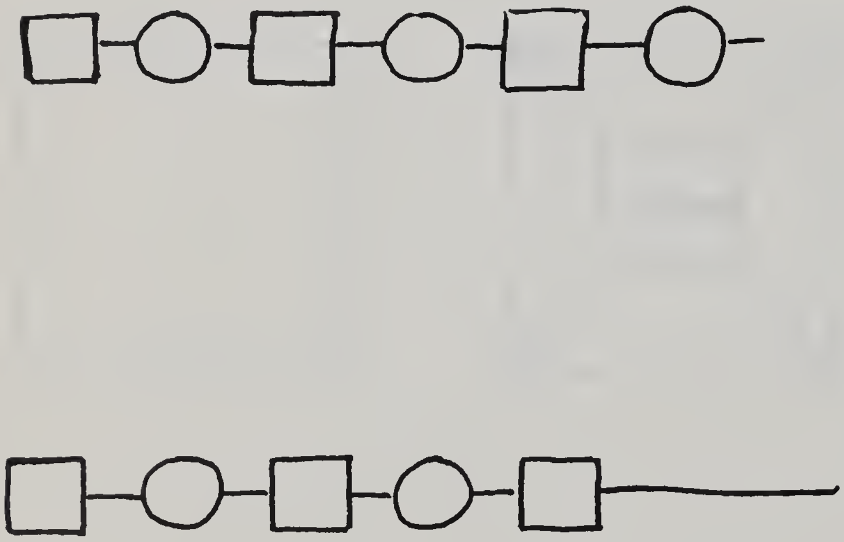


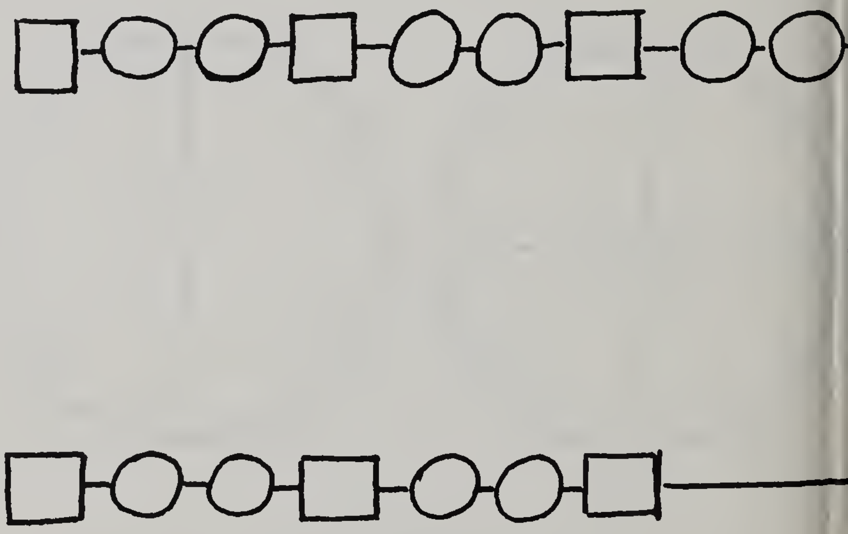


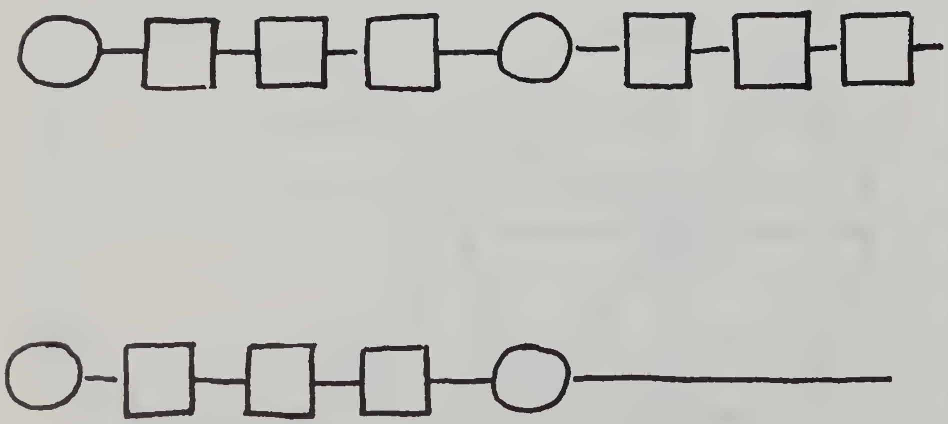


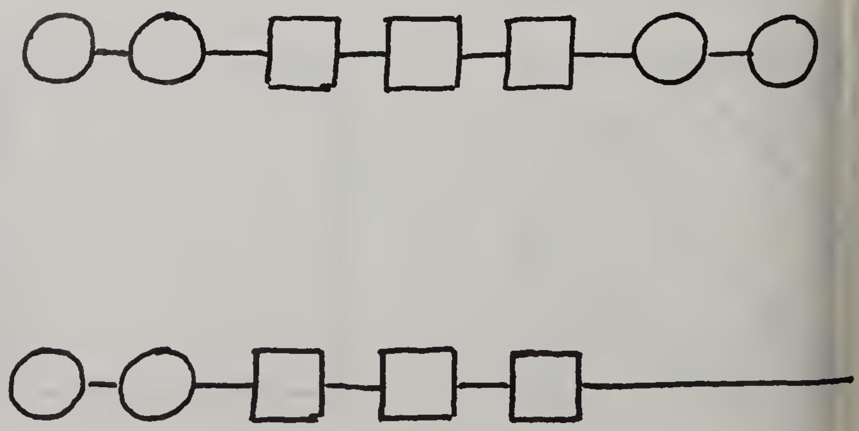












Visual Discrimination Tests

Name ______________________________

School ____________________ Room ______

Date of birth Year ____ Month ____ Day ___

C.A. ________ M.A. ________ I.Q. ________ Sex ____

Test	Score
1	
2	
3	
4	
5	
6	
Total	

E	F	E	H	K	L	T
F	E	H	F	L	T	K
R	P	B	S	R	A	K
Y	V	W	Y	X	M	N
B	D	P	R	S	O	B
D	P	B	R	S	O	D
a	s	c	d	a	q	e
b	h	m	n	p	r	b
c	e	d	a	c	q	s
m	n	b	h	p	m	r
k	v	w	x	y	k	f
r	m	n	h	r	p	b

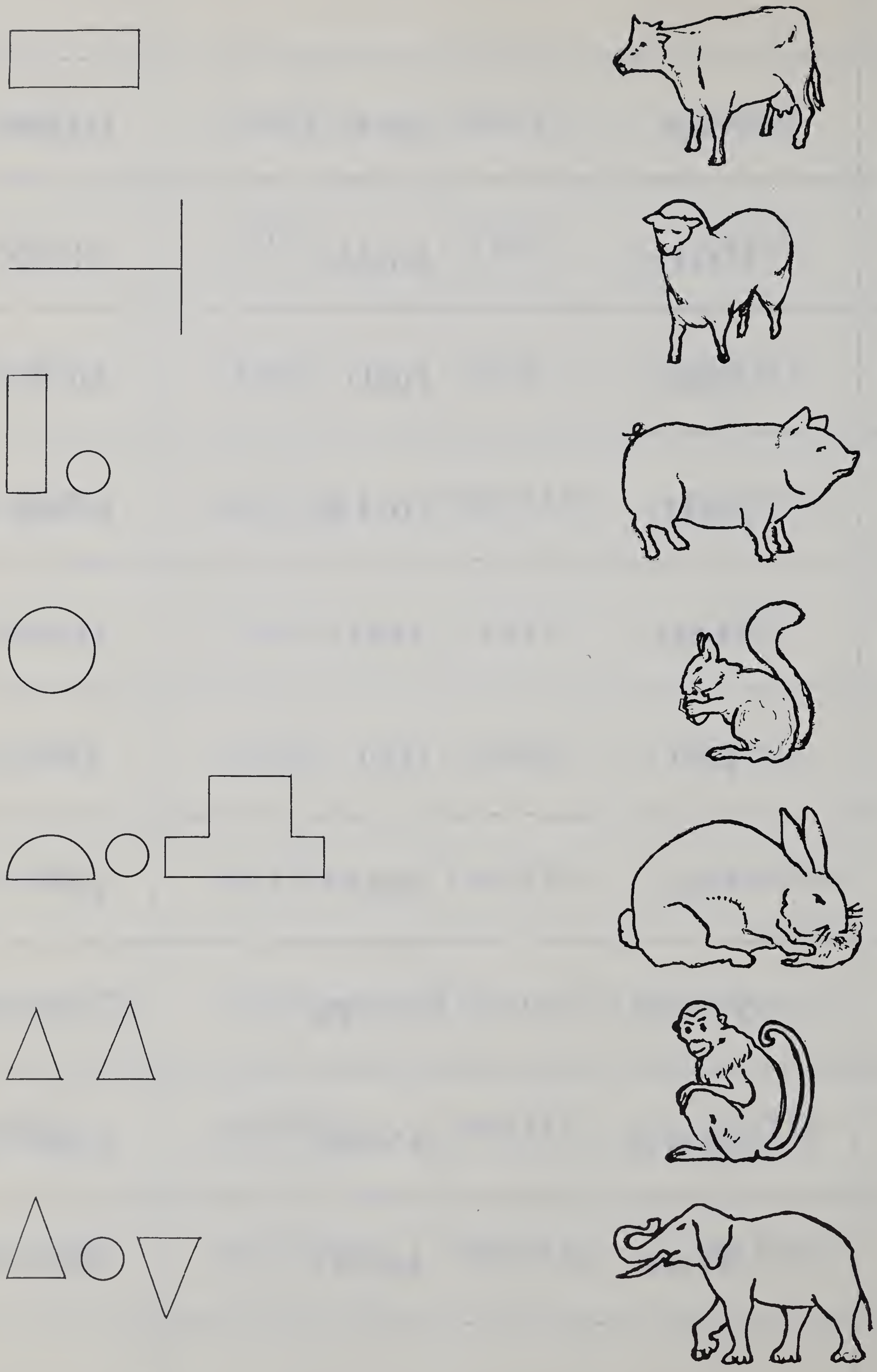
b	c	a	q	d	p	b
d	a	b	c	q	d	p
m	n	u	r	j	m	c
p	b	q	p	d	c	a
r	j	u	c	r	m	n
u	m	n	u	r	c	j
C	D	C	G	K	Z	N
D	C	G	D	N	Z	K
K	Z	N	K	G	C	N
W	M	V	Y	X	W	A
A	V	M	W	A	T	L
M	W	N	X	V	M	A

come	ecom	come	meco
hop	kep	bge	hop
jumble	jumble	puddle	dledu
break	kreak	break	draek
drippy	driddy	yppad	dripp
traffic	fittant	traffic	ballri
pup	gup	puy	pup
Bick	Reak	Paah	Bick
Molly	Molly	Metty	Yollp
waves	sevaw	sevwa	waves

jump	hump	bump	lump	jump
ran	can	man	ran	van
hill	pill	will	hill	till
boat	boat	coat	goat	float
sing	ring	king	wing	sing
mad	man	map	mad	mat
can	cat	can	cap	cab
lap	lab	lap	lad	lag
trip	trim	trill	trip	trick
wet	web	wed	well	wet

bed	bad	bed	bid	bud
rub	rib	rab	rub	rob
hat	hot	hit	hut	hat
spoon	spoon	spoun	speen	spea
cut	cat	cut	cet	cot
cap	cup	cop	cap	cip
bottle	battle	bottle	buttle	bett
drip	drop	drup	drap	dri
silly	sully	sally	silly	soll
moon	moon	mean	mien	mou

saw	was	saw	mas
bull	dull	bull	llub
bed	deb	beb	bed
play	yalp	help	play
ban	ban	nab	dan
dot	pot	dot	bot
pat	tap	dat	pat
Carry	yrraC	Darry	Carry
Away	yawA	Away	yawV
Mat	Wat	taM	Mat



VISUAL DISCRIMINATION TESTS

Directions for Administering

FIRST DAY

Test 1. Today we are going to learn about some animals. The names of the animals are not written like words. I'll show you a sign which means the name of the animal.

SHOW PICTURE AND CARD NO. 1.

Look at this!

This sign says s h e e p. Point to the card.

This sign says s h e e p.

SHOW PICTURE AND CARD NO. 2

Look at this!

This says p i g. Point to card.

This says p i g.

REPEAT WITH CARDS NO. 3. c o w

4. s q u i r r e l

5. r a b b i t

6. e l e p h a n t

7. m o n k e y

BEGIN AGAIN WITH CARD NO. 1.

Show card.

This says p i g (pause). What does it say? Wait while class replies p i g.

CONTINUE WITH CARDS NO. 2 - 7.

FINAL PRESENTATION AT CONCLUSION OF TESTING PERIOD FIRST DAY.

Distribute Booklets and Markers

Page 2. (Test 2) Matching Rotated Forms

(Help pupils to fold back page 2)

Put your markers under the top row.

(check and help)

Now draw a ring around the first litte t r e e. Now look at all the other t r e e s in the top row and find another t r e e that is just like the first one. Draw a ring around it.

HELP PUPILS WHO DO NOT UNDERSTAND BUT DO NOT INDICATE MATCHING TREE

Slide your marker down so you can see the row of f l a g s. Draw a ring around the first flag. Now find another flag that is exactly like the first one and draw a ring around it.

Slide your marker down so you can see the row of s h o v e l s Draw a ring around the first shovel. Now draw a ring around the other shovel that is just like it.

Slide your marker down so you can see the row of b a l l o o n s. Draw a ring around the first balloon. Now draw a ring around the other balloon that is just like it.

REPEAT FOR: b l o c k s

u m b r e l l a s

s k i p p i n g r o p e s

p e n c i l s.

FIRST DAY

Page 3. (Test 3) Matching Rotated and Reversed Forms

Put your marker under the top row of f l a g s. Draw a ring around the first flag. Now draw a ring around the other flag that is just like it.

Slide your marker down so you can see the row of c u p s. Some of the cups are turned around. Draw a ring around the first cup. Now draw a ring around the other cup that is just like it.

Slide your marker down so you can see the row of b o a t s. Draw a ring around the first boat. Now draw a ring around the other boat that is just like it.

REPEAT FOR: s o c k s

m i t t s

c h a i r s

p a n s

f l o w e r s.

FIRST DAY

Page 4. (Test 4) Immediate Visual Memory

Put your marker under the top row of b o x e s.

SHOW CARD NO. 1. (Practice item)

Look at this picture.

Now find the one that is just like this one and draw a ring around it.

CHECK AND HELP PUPILS.

Slide your marker down so you can see the next row.

Look at this picture. SHOW CARD NO. 2

Now find the one that is just like this one and draw a ring around it.

CORRECT PUPILS IF THEY ARE NOT LOOKING AT RIGHT ROW.

REPEAT FOR CARDS NO. 3.

4.

5.

6.

7.

8.

9.

FIRST DAY

Pages 5, 6, 7, 8, 9, 10. (Test 5) Pattern copying.

Practice item.

Look at the top picture. Page 5.

You draw that picture.

CHECK AND HELP. ALLOW APPROPRIATE TIME.

Look at the other picture. You draw that?

ALLOW APPROPRIATE TIME.

REPEAT FOR PAGES 6, 7, 8, 9, 10.

Page 11 and 12. (Test 6)

Look at these first two pictures. DEMONSTRATE WITH EXAMPLE.

Draw a line in this box so that these two boxes will look exactly alike.

Practice item. CHECK AND HELP.

Look at these two circles. Make them look just alike.

Look at the two boxes. Make them look alike. You finish the picture.

Look at these two circles at the top. Make them look alike.

TURN PAGE.

Make the first two boxes look alike. You finish it.

Now make the other two boxes look alike. You finish the picture.

Look at these two strings of beads. See where some bead is missing on this string? (point) Draw the bead on this string where it is missing.

FIRST DAY

Page 11 and 12 (Test 6) Continued.

Look at these two (top right). More than one bead is missing. Fix this string of beads so that these two strings of beads are alike.

REPEAT FOR THE LAST TWO. CORRECT RESPONSES.

FINAL PRESENTATION OF TEST 1.

USE CARDS ONLY -- NO PICTURES.

Show Card No. 1.

Do you remember which animal this card means? or stands for? (pause).

S h e e p is right. Let's say it: s h e e p.

CONTINUE WITH CARDS NO. 2.

3.

4.

5.

6.

7.

END OF FIRST DAY'S TESTING

SECOND DAY

DISTRIBUTE BOOKLETS. INSTRUCT PUPILS TO LEAVE THEM AS PLACED.

Yesterday we learned some signs. Do you remember?

One was r a b b i t, one was e l e p h a n t

s q u i r r e l

m o n k e y

c o w

p i g

s h e e p.

These books today have the pictures of the animals and also the signs you learned but the animals are not in the right order.

Now turn your book over. Put your finger on the first sign at the top.

DEMONSTRATE. CHECK AND HELP.

Which animal (big sign name) did you learn for this sign?

WAIT FOR REPLY s h e e p.

Now join the s h e e p to this sign with a line.

Draw a line from the sign to the s h e e p.

CHECK AND HELP. (Practice item).

Look at the next sign. Think of the animal you learned for this sign but don't say it. Just draw a line to the right animal. [NO FURTHER HELP.]

Look at the next sign. Find the right animal and draw a line to it.

Go ahead and finish the page.

AS SOON AS INDIVIDUAL PUPILS ARE FINISHED CIRCULATE AND TURN OVER BOOKS.

TERMINATE WHEN APPROPRIATE.

SECOND DAY

Page 2. (Test 1.)

HELP PUPILS FOLD BACK PAGE.

Put your marker under the top line. Draw a ring around the first letter.

DEMONSTRATE BY POINTING TO FIRST LETTER. CHECK AND HELP.

Now find the other letter that is just like it. (NO HELP) and

draw a ring around it.

IF PUPILS SEEM CAPABLE THEY MAY FINISH PAGE INDEPENDENTLY.

IF NOT, FURTHER DIRECTIONS FOR THE NEXT LINE MAY BE GIVEN.

Page 3. (Test 2)

REPEAT DIRECTIONS FOR PAGE 2.

Page 4, 5, 6, 7 (Tests 3, 4, 5, 6.)

REPEAT DIRECTIONS FOR PAGE 2 BUT SUBSTITUTE "WORD" for "LETTER".

COLLECT BOOKLETS BEFORE PUPILS HAVE AN OPPORTUNITY TO REVIEW PAGE 8.

SCALE FOR RATING PATTERN COPYING AND PATTERN COMPLETION

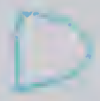
GENERAL PRINCIPLES

SQUARES OR RECTANGLES

To be awarded credit designated in the specific directions for each pattern, a square or rectangle:

1. must be a quadrilateral.

2. must have three fairly good right angles and the fourth angle must have a definite point where line changes direction. No credit is given for:

   rounded corners  or ears. 

CIRCLES

With regard to external details there must be no break or unjoined lines in the circumference if any credit is to be given.

 No  Yes 

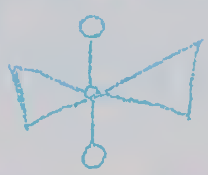
No mark if more than half the circumference is distorted.

TRIANGLES

Must have three angles and not more than three sides for credit.

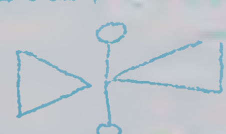
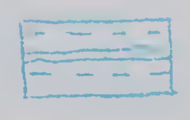
SIZE

2 marks credit if the vertical measurement of the figure is within $\frac{1}{2}$" of original.

Exceptions:  and  measure width.

All figures are measured through centre when judging length or width. Measurement of right or left sides not considered.

1 mark credit for size if vertical measurement of figure is within 3/4" (longer or shorter) of original.

Measure width for  and 

PLACEMENT (Pertains to Pattern Copying only)

Deduct one mark from total for test for each pattern showing total displacement on page.

PATTERN COPYING

Total is 8 points per drawing. Size - 2 points.

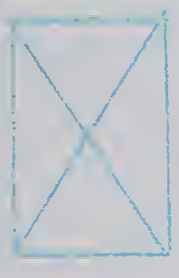
Pattern detail (external and internal) - 6 points.

Placement - for total displacement of a figure, deduct
one mark from test total.

Pattern 1

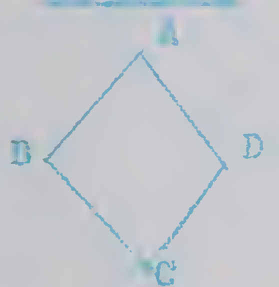
1 mark if half the circumference is good.
Add 1 mark if circumference is good in three quadrants with not more than a slight distortion in the fourth quadrant.
Allow mark if figure is slightly elliptical.
2 marks for any two lines obviously intended to be parallel.
Add 1 mark if lines are equidistant from center.
Add 1 mark if space between lines is within 1/16" larger or smaller than original. Take center as point of measurement.

Pattern 2



1 mark for a quadrilateral with four angles approx. 90° (according to the general principles).
Add 1 mark if vertical sides are longer.
Add 1 mark if vertical and horizontal sides are within $\frac{1}{4}$" of correct length and width.
2 marks if diagonals touch all four corners and bisect (approx.) each angle.

Pattern 3



2 marks for a quadrilateral obviously intended to be diamond shaped.
Add 1 mark if any 2 sides are equal.
Add 1 mark if any 4 sides are equal.
Add 2 marks if AC and BD are in a straight line if imaginary perpendiculars were erected through center of figure.
Slight rotation of figures makes no difference.

Pattern 4

2 marks for quadrilateral with required angles.
Add 1 mark if 4 sides are equal. Allow $\frac{1}{8}$" more or less.
Add 1 mark for presence of one horizontal and one vertical line not more than half distance from top side and left side. Lines must practically touch sides intended.
Add 1 mark if lines intersect at 90°.
Add 1 mark if intersecting lines are correct distance (allow 1/16" error) from left and top corner.

Pattern 5

2 marks for triangles (1 for each - see general principles).
Add 1 mark if A and F are in a straight line, (i.e. if their apexes are opposite.)
Add 1 mark if BC and DE are approx. equal in length.
Add 1 mark if space between BC and DE is correct in proportion to size of triangles.
Add 1 mark if BC and DE are parallel.

Pattern 6

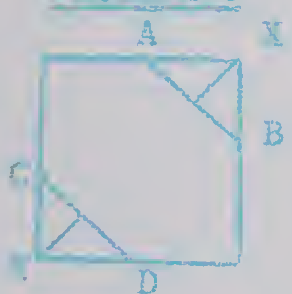
2 marks - one for each quadrilateral with required angles.
Add 1 if both quadrilaterals have equal (approx.) sides.
Some variation in size of square is permitted.
Add 1 for any form of overlapping at corners, not more than half.
Add 1 if AB is bisected.
Add 1 if CB is bisected.

Pattern 7

2 marks for two triangles placed thus:
some rotation permitted.
Add 1 mark if triangles meet at centre.
Add 1 mark if vertical intersects at any angle.
Add 1 mark if intersects at 90°.
Add 1 mark if balls on are approximately correct size and correctly drawn (attached to it but not enclosing part of it).

Yes No

Pattern 8



2 marks for a quadrilateral with angles.
Add 1 mark if 4 sides are equal (i.e. within $\frac{1}{8}$")
Add 1 mark if 4 lines are present at AB, CD and from corners X and Y to those lines.
Add 1 if placement of lines is correct in proportion to size of square (allow 1/16")
Add 1 mark if lines from X and Y corners meet AB and CD at 90° approximately.

Pattern 9

2 marks - 1 for each triangle placed so:
Some rotation allowed.
Add 1 mark if triangles touch at centre.
Add 1 mark for presence of 2 interior triangles (in approximately correct positions with apexes toward AB and CD).
Add 2 marks (1 for each) for small triangles touching all three sides of large triangle.

Pattern 10

1 mark for the circle [illegible]
Add 1 mark for each petal touching circumference and centre (shape of petal not considered) (4 marks)

Add 1 mark if all 4 petals are correctly shaped.

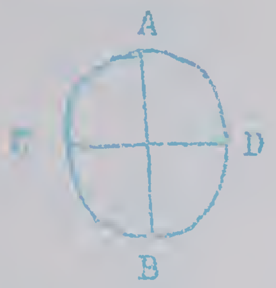
Pattern 11

1 mark for a quadrilateral with required angles.
Add 1 if width and length are in proportion.
Add 2 marks if 4 horizontal lines (2 solid in centre and 2 dotted on either side)
1 mark for solid lines
1 mark for dotted lines
Add 1 mark if solid lines equidistant from centre, and space between is within 1/16" of original.
Add 1 if dotted lines are placed nearer horizontal sides of rectangle than to centre.

RATING SCALE FOR PATTERN COMPLETION

Pattern 1

Total is 6 points for each pattern.



2 marks for presence of any diameter.

Add 2 marks if diameter is in a horizontal position intersecting AB at any angle.

Add 2 marks if CD bisects AB at 90°.

Pattern 2

1 mark for any diamond (size and spacing not considered.)

Add 2 marks for any 4 connecting lines from diamond to corners of square.

Add 1 mark if all four connecting lines bisect (approx.) sides of inner diamond.

Add 1 mark if 2 corners of diamond touch side of square.

Add 1 mark if 4 corners touch.

Pattern 3

1 mark for 2 diameters (touching circumference not considered.)

Add 1 mark if diameters intersect at center at 90°.
Add 1 mark for any two triangles added to diameters.
Add 1 mark for 4 triangles added to diameters.
Add 1 mark if 2 triangles are approx. correct - size, touch circumference, and have diameter passing through triangle.
Add 1 mark if all 4 triangles qualify.

Pattern 4

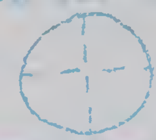
1 mark for any interior quadrilateral size and spacing not considered. *

Add 1 mark for 2 connecting diagonals from corner of small square to corner of large square.
Add 1 mark for 4 connecting diagonals.
Add 1 mark for one line bisecting small square.
Add 1 mark for two lines bisecting small square (approx.).
Add 1 mark if size of small square is approx. correct.

* See general directions.

Pattern 5

2 marks - 1 each for one horizontal and 1 vertical diameter:



All diameters must be continuous through centre with no change of direction at centre.

Add 1 for:

(dotted lines)

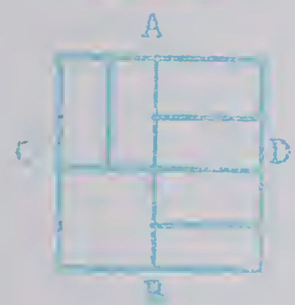
and 1 for

(bisects approx.)

Add 1 if - no extra diameters are added.

Add 1 if all 4 diameters pass through pupil's centre.

Pattern 6



AB and CD must be continuous. No credit for half a line.

1 mark for AB) bisects sides (approx.)
1 mark for CD)

Add 1 mark for each line bisecting (approx.) quarters as on model square (three altogether).

Add 1 if no extra lines are added.

No credit for bisecting if AB and CD are not continuous.

Pattern 7

1 mark for the diagonals EH and FG (no half marks).

Add 1 mark for triangle EAF (should not be merely a
Add 1 mark for triangle GDH continuation of sides of square.

Add 1 for AB at any angle. Add 1 for CD at any angle.

Add 1 if CD and AB are approx. perpendicular to sides of square.

Patterns 8, 9, 10 and 11 - Beads

2 marks for each correct and complete response.

(Size and spacing not considered)

No partial marks - right or wrong.

APPENDIX D

RECORD FORM FOR THE VISUAL SCREENING TEST

V I S U A L   S C R E E N I N G   T E S T

Teacher ______________________

School ______________ Address ______________ Grade ________ Date ________

<table>
<tr><td rowspan="3">NAME</td><td colspan="6">[illegible]</td><td colspan="3">STEREO-SCOPE</td><td colspan="11"></td><td colspan="2">RECOMMENDATION</td><td rowspan="3">Comments</td></tr>
<tr><td rowspan="2">Sex</td><td rowspan="2">Date of Birth</td><td rowspan="2">C.A.</td><td rowspan="2">Wearing Glasses</td><td rowspan="2">Distance Symptoms</td><td rowspan="2">Near Symptoms</td><td rowspan="2">Suppression</td><td rowspan="2">Fusion</td><td rowspan="2">Stereopsis</td><td rowspan="2">Ophthalmoscope</td><td colspan="3">COVER TEST</td><td rowspan="2">Near Point Convergence</td><td rowspan="2">Vertical Phoria</td><td colspan="2">Lateral Phoria</td><td rowspan="2">Visual Acuity Nearpoint</td><td rowspan="2">Visual Acuity Farpoint</td><td rowspan="2">Pass</td><td rowspan="2">Refer</td></tr>
<tr><td>[illegible]</td><td>[illegible]</td><td>[illegible] Accuracy</td><td>Near Point</td><td>Far Point</td></tr>
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APPENDIX E

SUMMARY DATA FOR ANALYSES OF VARIANCE

I. SEX VERSUS METHODS

Sexes	Learning Methods				
	Visual	Auditory	Kinaesthetic	Combination	Total
Boys (n=31)	154	149	105	124	532
Girls (n=31)	138	127	138	129	532
Total (N=62)	292	276	243	253	1064

II. MENTAL AGE VERSUS METHODS

Mental Age Groups	Learning Methods				
	Visual	Auditory	Kinaesthetic	Combination	Total
High 89-124 mo. (n=16)	101	88	74	79	342
Middle 79-88 mo. (n=30)	126	128	131	128	513
Low 64-78 mo. (n=16)	65	60	38	46	209
Total (N=62)	292	276	243	253	1064

III. CHRONOLOGICAL AGE VERSUS METHODS

Chronological Age Groups	Learning Methods				
	Visual	Auditory	Kinaesthetic	Combination	Total
Group I 78-80 mo. (n=25)	135	126	105	115	481
Group II 75-77 mo. (n=23)	111	102	101	85	399
Group III 70-74 mo. (n=14)	46	48	37	53	184
Total (N=62)	292	276	243	253	1064

IV. CLASSES VERSUS METHODS

Classes	Learning Methods				
	Visual	Auditory	Kinaesthetic	Combination	Total
Class I (n=22)	72	71	59	75	277
Class II (n=20)	118	113	102	96	429
Class III (n=20)	102	92	82	82	358
Total (N=62)	292	276	243	253	1064

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